OPERATION MANUAL

M8000

Multislice CT Imaging Systems

Volume 1

Part No. 490-7180-4006



PHILIPS



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Philips Medical Systems (Cleveland), Inc. Quality Assurance

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December, 2001 (revised)

DECLARATION OF CONFORMITY

We, Philips Medical Systems (Cleveland), Inc., declare that the products listed herein conform to the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.

Approval Certificate to Annex II, Article 3, issued by TUV Rheinland

Products (Model names):

PQ Series CT Scanners, Single Slice and Spiral CT Scanner
Ultra Z CT Scanner, Single Slice and Spiral CT Scanner
AcQSim-CT CT Scanner, Single Slice and Spiral CT Scanner
MxTwin CT Scanner, Multi-Slice Spiral CT Scanner
Select CT Scanner, Single Slice and Spiral CT Scanner
Mx8000 CT Scanner, Multi-Slice Spiral CT Scanner
Mx8000D CT Scanner, Multi-Slice Spiral CT Scanner
CT Scanner Accessories - FACTS, Pin Point, MxView, Voxel Q
Axis, Irix and Meridian Gamma Cameras and Accessories
Eclipse, E99, Polaris, and Apollo MRI Products and Accessories
Infinion 1.5T MRI System
Voyager - IGS Products and Accessories

Manufacturer:

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DOCUMENT EFFECTIVITY

E.C.O.	REV.	DATE	DESCRIPTION	СНАР.	PAGES	APPR.
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E13000067	1	Jun 2001	Release v2.2	All	All	S. Rubinstein
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Diagnostic Imaging Systems

RADIATION WARNING

X-RAY AND GAMMA RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO PATIENTS AND PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO LEAKAGE RADIATION FROM WITHIN THE SOURCE HOUSING OR TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS," AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE, " AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR THE PLANNING OF X-RAY AND GAMMARAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV," AS REVISED AND REPLACED IN THE FUTURE.

FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

Diagnostic Imaging Systems

MECHANICAL - ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECT SWITCHES ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO **NOT**, UNDER ANY CIRCUMSTANCES, REMOVE THE FLEXIBLE HIGH TENSION CABLES FROM THE X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR THE ACCESS COVERS FROM THE GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE ABOVE MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

THE INSTALLATION AND SERVICE OF EQUIPMENT DESCRIBED HEREIN IS TO BE PERFORMED BY AUTHORIZED, QUALIFIED PHILIPS MEDICAL SYSTEMS PERSONNEL. ASSEMBLERS AND OTHER PERSONNEL NOT EMPLOYED BY NOR DIRECTLY AFFILIATED WITH PHILIPS MEDICAL SYSTEMS TECHNICAL SERVICES ARE DIRECTED TO CONTACT THE LOCAL PHILIPS OFFICE BEFORE ATTEMPTING INSTALLATION OR SERVICE PROCEDURES.

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CAUTION

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.





LASER RADIATION – DO NOT STARE INTO BEAM

DIODE LASER – MAX OUTPUT POWER 1.0mW 650 NM EMITTED WAVE LENGTH

"CLASS II LASER PRODUCT"

PUBLICATION IMPROVEMENT RECOMMENDATION

Users of this publication are encouraged to report errors, omissions, and their recommendations for improving this publication. This sheet is published for that purpose. To file a Publication Improvement Recommendation, fill in the information requested below, fold, tape, and mail this prepaid business reply form.

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The following Information was discovered during:
☐ Installation ☐ Other (specify)
Recommendation: (Please be specific by referencing your remarks to page numbers, step numbers, etc.)
(continue other side)
Your Name
Service Office
Telephone

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Safety Guidelines

General



Warning

The x-ray unit may be dangerous to patient and operator unless safe exposure factors and operating instructions are observed.



Caution

United States Federal Law restricts this device to sale, distribution and use by or on the order of a physician.

- 1. This product was designed and manufactured to ensure maximum safety of operation. It should be operated and maintained in strict compliance with the safety precautions, warnings and operating instructions contained herein
- **2.** This product should be installed, maintained and serviced by Philips personnel or other qualified personnel approved in writing by Philips according to procedures laid down by Philips.
- **3.** The system in whole or in part should not be modified in any way without prior written approval by Philips.
- **4.** The owner should make certain that only properly trained and fully qualified personnel are authorized to operate this equipment. An authorized operators list should be maintained.
- **5.** It is important that this manual should be kept at hand, studied carefully and reviewed periodically by the authorized operators.
- **6.** Philips makes no representation, however, that the act of reading this manual renders the reader qualified to operate, test or calibrate the system.

- **7.** Unauthorized personnel should not be allowed access to the system.
- **8.** Under no condition shall the patient be left unobserved within the region of study.
- **9.** If the product does not operate properly or if it fails to respond to the controls described in this manual, the operator should:
 - A. Ensure the safety of the patient and then the safety of the equipment.
 - B. Follow safety precautions as specified in the safety chapter.
 - C. Freeze the situation and prevent any changes.
 - D. Immediately contact the nearest Philips field service office, report the incident and await further instructions.
- 10. The images and calculations provided by this system are intended as tools for the competent user. They are explicitly not to be regarded as a sole incontrovertible basis for clinical diagnosis. Users are encouraged to study the literature and reach their own professional conclusions regarding the clinical utility of the system
- **11.** The user should be aware of the product specifications and of system accuracy and stability limitations. These limitations must be considered before making any decision based on quantitative values. In case of doubt, please consult a Philips office.
- **12.** The system has been designed to meet all the safety requirements applicable to medical equipment. However, anyone attempting to operate the system must be fully aware of potential safety hazards.

Warnings, Cautions and Notes are used throughout this manual.

- **Warnings** indicate precautions and instructions which, if not followed, may result in personal injury or even death.
- Cautions indicate instructions which, if not followed, may result in damage to the equipment or to the quality of clinical studies.
- *Notes* are used in *italics* to provide information helpful in obtaining optimal performance from the equipment.

1 - 2 Nov 2001

General Hazards

Electrical Shock Hazard

Do not remove or open system covers or plugs. Internal circuits use high voltage capable of causing serious injury.

Electrical Fire

Conductive fluids that seep into the active circuit components of the consoles may cause short circuits that can result in electrical fires. Therefore, do not place any liquid or food on any part of the consoles or other modules of the system.

Explosion Hazard

Do not operate the equipment in the presence of flammable or explosive liquids, vapors or gases. Do not plug in or turn on the system if hazardous substances are detected in the environment. If these substances are detected after the system has been turned on, do not attempt to turn off the unit or to unplug it. Evacuate and ventilate the area before turning off the system.

Implosion Hazard

Do not subject the system to serious mechanical shock, as the cathode ray tube (CRT) can fracture if struck or jarred. This may result in flying pieces of glass and phosphor coating that can cause serious injury.

Potential Pacemaker Hazard

Though the possibility of interference with pacemakers is small, the operator should be alert to such a potential hazard from any equipment using a high frequency electrical signals.

IEC-601 Classification

1. Type of protection against electric shock:

Class I equipment.

2. Degree of protection against electric shock:

Type B equipment.

3. Degree of protection against harmful ingress of water:

Ordinary equipment.

4. Possible Interference with other Equipment:

IEC 601-1-2 Class B Device for both Emission and Susceptibility.

5. Mode of operation:

Continuous mode with short time loading.

Electrical Ratings

Voltage (VAC)	Phase	Frequency (Hz)	Power Consumption (KVA)	
			Continuous mode	Short time loading
380	3	50/60	8	90
400	3	50/60	8	90
420	3	50/60	8	90
440	3	50/60	8	90
460	3	50/60	8	90
480	3	50/60	8	90

1 - 4 Nov 2001

Environmental Protection

Philips is committed to the protection of the environment and natural resources. Our devices are manufactured under strict guidelines to prevent contamination of the surrounding water, ground and air.

The majority of the materials in this product (for example, metals, covers, electronics, etc.) are recyclable. Philips encourages its customers to dispose of the product at the end of its useful life, for recycling.

The following materials are hazardous to the environment. They must be segregated and disposed of properly:

- 1. All batteries: according to local regulations.
- 2. X-ray tubes.

Owner's Responsibility

It is the owner's responsibility to ensure that anyone using the system reads and understands the Operation Manual and other relevant literature, and fully understands them.

The owner should ensure continuous power supply to the system, with voltage and current according to Philips's specifications. If power outages are not infrequent, a UPS (Uninterruptible Power Supply) should be installed on the computer power line to avoid loss of data.

System Operation and Maintenance

The system should be operated and maintained in strict compliance with the operating instructions contained in this manual.

Safety Precautions

- **1.** The system in whole or in part may not be modified in anyway without prior written approval by Philips.
- **2.** If there is any sign of danger to the patient, press any one of the three red **STOP** buttons located on the Scan Panel of the Operation Station and on both sides of the Gantry front cover.
- **3.** Familiarize yourself with the manual Table Release procedure. Practice it several times in order to be ready to react immediately in a real emergency.
- **4.** If the product does not operate properly or if it fails to respond to the controls as described in this manual, proceed according to the appropriate following measures:
 - To stop all scanner motions and X-ray generation, press on any red **STOP** button located on both sides of the Gantry front cover and on the Scan Panel.
 - If the patient's body comes in contact with the Gantry and if
 there is danger to the patient's safety, then press the red
 STOP button and release the patient manually as described in
 the section on Safety Devices and Procedures.
 - If the patient is safe and if there is no dangerous contact with the scanner, return the system to normal operation according to section Returning the System to Normal Operation below.
 - If there is any indication that X-rays are not turned off after scan, press the **STOP** button and switch off the power by turning off the main switch on the wall.
 - Release the patient after stopping all Gantry and table motions.
 - Immediately contact the nearest Philips field service office, report the incident and await further instructions.
- **5.** Only qualified service personnel are authorized to change fuses.

1 - 6 Nov 2001

Safety Devices and Procedures

General

The system is equipped with safety devices to ensure the safe operation of the table and Gantry movements and to stop all movements in cases where the patient comes in contact with the Gantry.

The safety devices are described in the following sections. All operators should familiarize themselves with the location, activation and release procedure of each device. The safety devices are:

- Main POWER switch
- STOP buttons
- Enable button on the Scan Control Panel (Chapter 2, Vol. 1 System Description).

Main Power Switch

The Main POWER switch is located on the wall. Familiarize yourself with the location of this switch.

STOP Buttons

The red **STOP** buttons halt all Gantry and table motions and X-ray generation.

The **STOP** buttons are located on both sides of the Gantry front cover and on the Scan Control Panel of the Operation Station.



Manual Patient Release

To **release** the patient, in case of power failure or if the **STOP** button is pressed, pull or push the stretcher in whichever direction enables easiest release and dismounting of the patient. If the stretcher does not move, press the **STOP** button.

If necessary, lower the patient's head by removing any supports or pillows and by turning his/her head to one side.

Returning the System to Normal Operation



Warning

After pressing the STOP button, the Gantry and table should remain immobile. If movements occur without pressing any motion button, switch OFF the system. If this does not help, switch OFF the Main Power switch on the wall and use the patient release procedure from the previous section.

If the patient is safe and if there is no dangerous contact with the scanner, then return the system to normal operation by turning the STOP condition OFF from the Operator station.



Warning

Make sure that the motion of the table is in the direction that will ensure that the patient can be easily released and will not get pressed against the Gantry covers.

1 - 8 Nov 2001

Patient Handling and Positioning

Immobilizing the Patient

If the patient moves in an uncontrolled fashion during acquisition, this not only causes motion artifacts, but the patient can also injure himself or herself.

If necessary, immobilize the patient with one or more immobilization straps. To do this, pull the straps through underneath the positioning mat and close them on top of the patient with the Velcro strip such that:

- the patient is positioned symmetrically and his or her arms are fixed.
- the patient's arms do not hang down over the sides of the table and cannot be crushed between the table top and the Gantry.

Fold all sheets, blankets and clothes around the patient so that they do not hang over the edge of the stretcher. Gather all materials under the restraining straps. This will assure that the stretcher is free of any loose ends or objects that may be caught under it.

Keep infusion lines and other equipment that are connected to the patient clear from the edges of the stretcher.

Fold the restraining straps, when not in use, over the positioning mat so they do not hang over the sides.



Warnings

- While moving the Gantry and the Patient Table, keep the
 patient under continuous observation to avoid pressing him/her
 against the Gantry, or disconnecting the infusion or
 resuscitation apparatus.
- During studies, the Patient Table or Gantry movements are automatic. Make sure that there is enough clearance between the patient and the Gantry. Before initiating scan, perform manual movements to check the clearance.
- Make sure that the patient is strapped securely to avoid dangling of the hands. Ensure that the patient is placed securely on the stretcher and is not in danger of falling.



Caution

Make sure that the correct scan parameters are entered to ensure correct left/right orientations.

Table Movements

Angle.

During a study planned on Surview or between sequences, pressing the **ENABLE** button -- allows automatically controlled horizontal positioning of the patient. It also provides automatically controlled changes of the Tilt

To move the table top and tilt the Gantry, use the Gantry Panel controls on both sides of the Gantry and the Scan Control Panel on the Operation station.

Movement of the patient table in this mode (via Scan Control Panel) is limited to five seconds. If further movement is required, release the button and press again.

- Movement of the patient table is executed at two speeds. After pressing the appropriate button, the table moves at a slow speed and after several seconds, if the button remains pressed, it proceeds to a higher speed.
- The button, located on the Scan Control Panel on the Operation station, enables safe horizontal positioning of the patient and operation of the Gantry tilt via the system computer during automatic computer-controlled movements.
- To stop movement, release the pressed button.
- While moving the table and Gantry, operators should be careful not to insert their feet under the table side covers or between the Gantry and table. Also avoid inserting fingers between the stretcher and the table carriage.

In **automatic mode**, when a motion requires the use of the **ENABLE** button, the following occurs.

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- A message is displayed on the monitor, prompting the use of the button.
- The **ENABLE** button lights up.
- Press the button. While the Patient Table is moving the light on the button starts *blinking* and continues until motion stops and the light goes off. When motion stops, the Patient Table and tilt are positioned in the desired location. If necessary, correct manually.
- To stop movement immediately, release the button.
- If the button was pressed before arriving at the desired position, press it again until reaching the planned position.

Patient Scanning



Warnings

Never leave the patient unobserved within the region of study. The blinking of displays can cause fits in epileptic patients.

Adhere to the following safety instructions and rules when performing a scan on a patient:

- 1. Close all doors of the Scan Room before a scan process is initiated. Unless given permission by the doctor in charge, allow no one to enter the Scan Room during the scan process.
- **2.** Advise the patient not to move during the positioning or scanning procedures.
- **3.** Ensure that the patient's fingers and clothing do not get caught in equipment during patient positioning.
- **4.** Advise the patients not to raise their heads or move their bodies during scans.
- **5.** Remind the patients not to touch any external apparatus, such as infusions and resuscitation equipment.
- **6.** Unchecked accessories can cause artifacts, injuries to the patient and operating personnel or damage to the equipment. Therefore, only use accessories approved by Philips and replace defective accessories by new original accessories immediately.
 - Check that the patient-supports (headholders, table mattress, stretcher extension, side rails, arm supports, leg support, knee support, pediatric cradle) are whole and not damaged. Check that the headholders and leg supports are securely locked to the stretcher.

If damages or defects should occur on the system (patient table, Gantry) on add-ons or accessories, safety of operation is no longer guaranteed. Watch out for such damages and have these parts repaired or replaced immediately.

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- **7.** After typing the Scan Increment value and pressing **ENTER**, check that the desired value was correctly typed.
- **8.** Before pressing the **MANUAL** or **AUTO SCAN** keys, check that all scan parameters, as displayed on the screen, were correctly entered.

Protection Measures

Take the following protection measures to protect both yourself and the patient.

Personnel - Anyone who has to be near the patient during scanning must observe the following precautions:

- **1.** Wear protective clothing (lead apron, etc.).
- **2.** Wear a PEN dosimeter and/or film badge.
- **3.** Stay in the zone shielded by the system, i.e. to the side of the Gantry or behind a mobile protective wall.

Patients - The physician is responsible for protecting the patient from unnecessary radiation.

- Always use a gonadal shield, if possible.
- Use the pediatric mode for children.
- Use C.A.R.E. products.

Weekly Tests of Safety Devices

Perform the following tests weekly. If any of the tests fail, call your service organization and do not operate the scanner until the problem is corrected.

- Prepare the scanner for scanning (see Chapter 2, Vol. 1 System Description). When the SCANNER READY indicator lights up on the Scan Control Panel, press the STOP button.
 The sound of the scanner braking to a stop should be heard.
 Next, try to move the Patient Table and tilt the Gantry using the buttons on the Gantry Panel, and ensure that no motion takes place.
- **2.** Repeat the above step for each of the **STOP** buttons, located on both sides of the Gantry cover and on the Scan Panel.
- **3.** Press a **STOP** button on the Gantry Panel. Pull the stretcher by the handle at the foot of the stretcher and check that the stretcher moves easily.
- **4.** Perform a Head scan using the Head Phantom in the center of the scan circle. Check with the CURSOR/LINE that the diameter of the large Plexiglas pin is 50 ± 1 mm.
- **5.** Check that the Mylar window that covers the slice plane is whole and undamaged.

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Cleaning the System

Use only soap and lukewarm water to clean the surface of the system including the table, head-holders and accessories. Do not use detergents or organic solvents to clean the system. Strong detergents, alcohol and organic cleaners may damage the finish and also cause structural weakening.

Be careful when cleaning buttons and the inside of the Gantry opening to avoid liquid leaking inside the Gantry.

Blood and **contrast** medium are health risks. Take safety precautions when removing blood or residual contrast medium.

Table and its Extensions

The table supports a maximum patient weight of 200 kg (440 lbs), evenly distributed. The table extensions can support a maximum weight of 30 kg (66 lbs).



Caution

The table, stretcher extension and headholders are designed to support patient in lying, and not sitting position.

Oil Leaks

The X-ray tube and the H.V. generator are cooled by oil. This is a closed-circuit system that is sealed.



Caution

If oil leaks are detected, shut down the scanner and immediately contact the nearest Philips field service office.

Radiation Warning Lamps



The radiation warning lamps on the Gantry operator panels, on the control box as well as site radiation warning lamps must light up if scanning has been triggered.

If a radiation warning lamp does not light up once a scan has been released:

- Shut down the system immediately and contact Customer Service.
- Press the STOP pushbutton or EMERGENCY OFF button, if there is danger to the patient or operating personnel.

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Warnings

- Do not stare into beam and instruct the patient not to stare into the beam.
- The use of optical instruments (e.g. eyeglasses with large diopter or mirrors) with this product will increase eye hazard.
- Ensure that, for head examinations, protective glasses are worn by the patient when the laser beams are on.

Warning Labels

Details of the Warning Labels located on the Gantry and Patient Table are tabulated below.

Label	Wording On Warning Label	Location & ID #
WARNING POWER IS SUPPLIED TO THESE PARTS EVEN IF UNIT IS TURNED OFF 705-7180-1409	WARNING! Power is supplied to these parts even if unit is turned off.	On the right leg, visible when cover is open.
WARNING! FOR CONTINUED PROTECTION AGAINST FIRE HAZARD, REPLACE FUSES WITH THE SAME TYPE AND RATING ONLY	WARNING! For continued protection against fire hazard, replace fuses with the same type and rating only.	On the rotor, visible when cover is open.
ATTENTION ELECTROSTATIC SENSITIVE DEVICES OBSERVE PRECAUTIONS FOR HANDLING	ATTENTION Electrostatic Sensitive Devices Observe precautions for handling.	On the gantry, visible when cover is open.
ATTENTION Do not place any objects on this surface. 705-7180-2308	ATTENTION Do not place any objects on this surface.	Patient table, stretcher facing the gantry and on PDC front door.
MARNING Rotating parts! Set switch S 301 to zero Before any work	WARNING! Rotating parts! Set switch S301 to zero before any work.	On the door, visible when cover is open.

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Label	Wording On Warning Label	Location & ID #
<u> </u>		On left leg, visible when cover is open.
CAUTION! Static Sensitive Do Not Handle Unless Wrist Strap is Worn 705-7170-3613	CAUTION! Static sensitive. Do not handle unless wrist strap is worn.	On the rotor-front (on the F.E.E.), visible when the cover is open.
WARNING! OIL CONNECTIONS ARE SENSITIVE MECHANICALLY DO NOT USE THEM AS HANDLES!	WARNING! Oil connections are sensitive mechanically. Do not use them as handles!	On the tube.
Caution! Electric shock hazard. Switch off the power before any work 705-7180-2209	Caution! Electric shock hazard. Switch off the power before any work.	On the front and rear sides of the gantry where slipring is placed, visible when the cover is open.

Label	Wording On Warning Label	Location & ID #
Caution! To reduce the risk of electric shock, do not remove this panel until 2 minutes have elapsed after turning off equipment.	Caution! To reduce the risk of electric shock, do not remove this panel until 2 minutes have elapsed after turning off equipment.	On the PDC and on H. V. unit on the gantry.
WARNING WHEN OPENING FRONT GANTRY COVER, ENSURE MATTRESS POSITIONING BY FOLDING THE MATTRESS FLAPS AND SECURING THEM WITH THREE STRAPS. 705-7180-3900	WARNING! When opening front gantry cover, ensure mattress positioning by folding the mattress flaps and securing them with three straps.	On the inside of the front gantry cover.

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System Description



The CT scanner is an advanced continuous-rotation tomographic system that consists of the following components:

- Gantry and Patient Table
- Computing System
- Monitor, Keyboard and Mouse
- Scan Control Panel
- Erasable Optical Disk (optional)
- AMC Automatic Filming Control device (optional)

Multi-Slice Gantry

The Mx8000 Series scanners are available in 4-slice and 2-slice configurations. The procedures for operating both systems are virtually identical. Where differences exist, they will be identified in this manual as "Quad" (4-slice) and "Dual" (2-slice).

Operating Station

The Operating Station is used to operate and monitor the scans being performed. It consists of the following components:



- 1. Computing System
- **2.** Scan Control Panel that consists of:
 - **ON/OFF** button
 - Scan operation buttons
 - Intercom
 - Gantry and Patient Table controls
 - Windowing controls
 - Emergency STOP button
- 3. Keyboard and Mouse
- 4. Display Monitor

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Computing System

The Computing system consists of the following:

- Silicon Graphics computer
- Image Reconstruction System
- Acquisitor

When the system needs to be switched **OFF**:

- 1. Log out
- **2.** Shut down
- **3.** Use the ON/OFF switch located on the front panel of the computer



Caution

Never interrupt the electric current to the computer when it is **ON**. Doing so could cause damage to the computing system or to the software.

Display Monitor

A 21" color high resolution monitor with 1280 x 1024 pixel resolution is used for displaying images and operating the system.

The monitor power switch is located on the front of the monitor. The monitor's power indicator light (LED) lights up when you turn on the monitor.



Caution

To maintain optimal adjustment and correlation with the filmed images, do not change the settings of the Display Monitor.

Patient Intercom

The Patient Intercom consists of a speaker and two microphones located in the opening of the Gantry. A speaker is on the underside and microphone on the topside of the Scan Control Panel.

Recorder Microphone

A recorder microphone is located at the rear of the operator's console. This microphone is used to record messages that are used during the scan process.

In some cases the microphone may be located at rear of the electronic rack.

Archives

The following devices are used for storing data:

- 1. Internal Hard Disks
- 2. EOD Erasable (Rewritable) Optical Disk (optional)

If the EOD option is installed, before turning ON the computer, turn ON the EOD and wait until its yellow LEDs are extinguished. (The ON/OFF switch is located at the back of the EOD case.)

Hard Disks

The 9 Gigabyte (GB) hard disk is used to store images, the operating system and calibration data. An additional 18 GB of disk space is used to store raw files and calibration data. Disk space can be expanded up to 36 GB.

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Erasable (Rewritable) Optical Disk (optional)

The **Erasable Optical Disk** (**EOD**) stores up to 4.1 GB of patient images and raw files on removable re-usable cartridges. 2.3 GB cartridges may also be used.

On the EOD front panel are two indicator LEDs: the lower one signals that the power is **ON** and upper one lights up when the EOD is busy.



Caution

The cartridge **must not** be released by the push button located on the front of the EOD. To release it correctly, click the EOD icon in the Archives Manager with the **right** mouse button and select **Eject**.

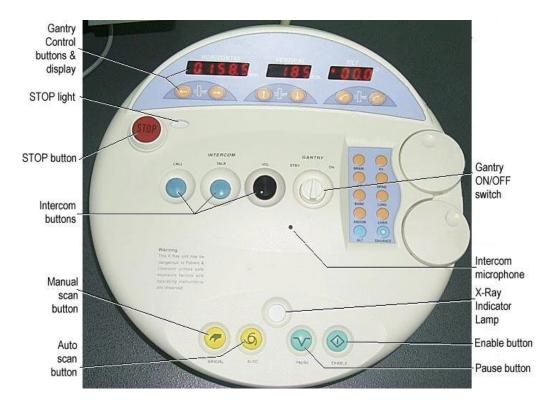
To **insert** a cartridge, push it into the slot.

AMC – Automatic Filming Control Device (optional)

This is an interface to Laser Imagers and DICOM printers. In conjunction with the MasterFilm function it enables film rearranging and automatic printing.

Scan Control Panel

The scanning process is initialized from the SCAN Toolbox on screen and controlled from the Scan Control Panel.



The Scan Control Panel consists of the following:

- **Gantry Control** buttons and displays for controlling and displaying Gantry Tilt angle and Patient Table movements.
- **STOP** Button used in case of an emergency to halt all Gantry motions and X-ray generation.
- **STOP** Light is lit when the **STOP** Button has been pushed and all Gantry and motions and X-ray generation are halted.
- **GANTRY ON/OFF** Switch for switching **ON** and **OFF** Gantry power.
- Intercom is used to communicate with the patient. It includes the CALL and TALK buttons and a Volume control for adjusting the volume level at which the patient is heard.

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- Pause/Stop

The **Pause/Stop** Button is used to interrupt the scanning series and enable the following changes:

- Stopping immediately the progress of Helix, Surview scans, and Axial series.
- Temporarily interrupting the scanning procedure to enable activation of post-processing functions.
- Changing the scanning and reconstruction parameters.
- Skipping the remaining scans in the current series and beginning the next series.
- Addition of one or several scans (Axial or Helix) to complement the just finished series.
- Stopping the exam. If the slices were planned on Surview, the Surview image is updated with the executed slices.
- To indicate that the patient moved.



- Manual Scan

The **Manual** button is used to perform individual scans by pressing

the button. The **Manual** light will go on when the scanner system is ready to execute non-timed series, one scan at a time.

The X-Ray ON indication lights up for the duration of the exposure. The **Manual** and **Auto** lights are not lit, denoting that the scanner is busy and pressing them will have no effect.

If Reconstruction is online or concurrent or evolving, the images are displayed on the screen and the **Manual** and **Auto** LEDs light up again. Another scan may then be performed.



The **Auto Scan** button is used to perform individual scans by pressing the button. The **Auto Scan** light will go on when the scanner system is ready to execute:

- non-timed Axial series, one series at a time and/or
- timed series, causing the complete set of series to be executed after the preset programmed delay has elapsed.

Press the **Auto Scan** Button to perform a series of scans without operator intervention. Successive scanning and reconstruction cycles for each slice are repeated automatically.

To change from automatic scanning to manual individual scanning, or to stop the automatic series, press the button.

For **Axial** series, it is possible for <u>both</u> the **Manual** and **Auto Scan** lights to be on simultaneously.



- Enable Button

This button enables the machine-controlled Patient Table and Gantry movements, as, for example, after **Plan on Surview** when the Patient Table and Gantry move to the planned position and tilt.

When prompted by a message on screen, and while watching the patient,

press and hold the **Enable** Button on the **Scan Panel** to begin patient table and Gantry motions. Releasing the button stops motions; pressing the button again resumes motions.

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Scan Window



The **Scan Window** is made up of eleven main components that are used with the mouse. They are:

- The **Title Bar** contains the name of the application. It is also used for
 moving the entire window by clicking and dragging it with the left mouse
 button pressed.
- The Menu Bar contains the names of the menus that are described later in this chapter. All of the options that are accessible through shortcut buttons or sliders also appear in the menus. Not all of the options available in menus appear as buttons or sliders. Most menu options are also accessible directly from the keyboard, without a mouse.

- The **Scan Toolbar** contains shortcut buttons, all of whose functions are also available in menus
- The **Scan Toolbox**, located at the upper left side of the window, is used for initializing the scan process; afterward scanning is controlled from the Scan Control Panel.
- The **Status Window** displays the current scan status.
- The **MasterFilm Monitor** is a visual indicator for filming.
- The **Time Indicator** window.
- The **Graphic Toolbar** offers shortcut buttons to graphic options.
- The **Image Viewing Area** displays the images according to your preferences.
- The **Image Slider** scrolls images in and out of the Image Viewing Area, in the same way the slider bar works in a PC environment.
- The **Windowing Sliders** offer control of Windowing.
- The **Windowing Toggle Buttons** switch between two windowing selections.
- The **Current Executing Status** is displayed near the bottom of the screen in the message line.

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Scan Window Toolbox





Patient Data

The **Patient Data** button initiates a new patient study and closes the previous patient study. It opens a form of the patient details to be filled at the beginning of the study and continues with Scan Protocol selection, Surview plan and scans.



Select Procedure or Protocol

The **Select Protocol** button enables setting or changing the scan protocol during the patient exam. The list of images representing the body regions is displayed for selection. After selecting the body region and the specific protocol, its parameters are displayed and scanning may be initiated.



Current Protocol

The Current Protocol button displays the scan protocol of the current series. The values of the parameters may then be changed for the rest of the series.



Surview Plan

This function is used to plan new series on Surview image. This button enables planning of the CT Axial and Helix series graphically on the Surview image. It is usually activated immediately after the Surview image is displayed. In addition it may be used to plan scans on Surview images from archives.



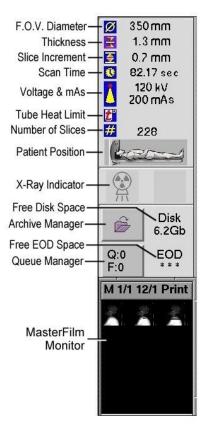
This button activates the (Batch) **Reconstruction** function.



Clicking the button halts the flow of the executed series and opens the **Examination Flow Dialog Box**.

Scan Status Display

The Scan Window Toolbox is beneath the Scan Status Display.



Parameters that have been entered in their appropriate fields (in a **Scan Protocol**) appear next to the icon that represents that parameter. Where parameters are not displayed, they are either not applicable in the current scan, or have not been entered. Displayed parameters are those of the current or next scheduled scan.

The **Tube Heat Limit** line displays the maximum number of scans that can be performed with the current parameters, due to Tube Heat Limitation. That number only relates specifically to the tube heat limitations, but the system could be limited further by other parameters.

The **X-Ray Indicator** flashes when X-Rays are being generated.

Free Disk Space is the amount of space on the Local Hard Disk that is free for saving images.

The **Archive Manager** button opens the **Archive Manager** to extract images from the archive.

Free EOD Space is the amount of space on the EOD that is free for saving images. A series of asterisks (***) indicates that there is a problem with the EOD, e.g. write protection of the EOD, the absence of an EOD in its slot, etc.

The **Queue Manager** displays a "**Q**" number for the number of images that are queued to be transferred. The "**F**" number represents the number of images that failed in transfer. Clicking on the button opens the Queue Manager.

The **Master Film Monitor** is a visual indicator for filming. Double-clicking inside the frame brings up the MasterFilm application. The Monitor reports the current filming status. In the above example, the **M** indicates that manual filming is enabled; **1/1** is the number of films in the film queue; **12/1** is the film format; and **Print** is the name of the current printer.

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Menu Bar

All of the options that are accessible through shortcut buttons or sliders also appear in the menus. Not all of the options available in menus appear as buttons or sliders.

<u>File Edit View Windowing Graphics Operations Options Processing Tasks Misc Help</u>

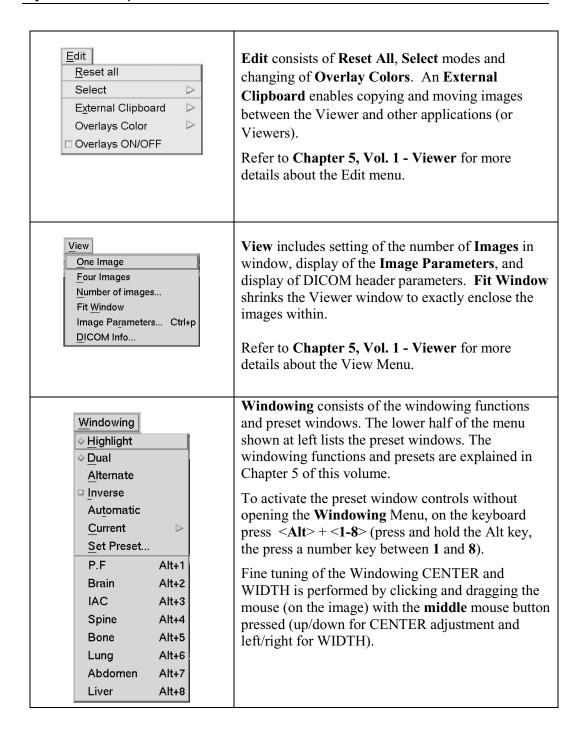
Some of the menu options are also accessible directly from the keyboard, without a mouse by pressing (and holding) the **Alt** key and then typing the letter that is underlined in the name of the menu.

The **Menu Bar** consists of several menu groups that are described below:

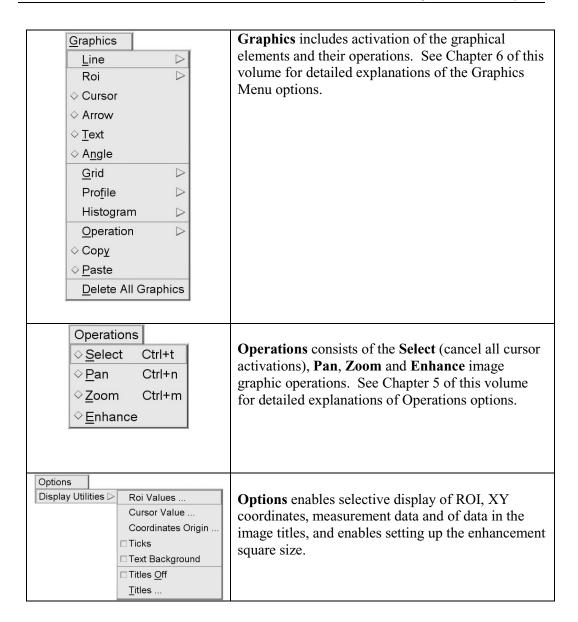
File
Open
Add Images
Add Groups
Refresh
Save Image(s)
Save As
Save As Multiformat
Film Image(s)
Film As Multiformat
MasterFilm
Queue Manager
Logout
Exit

File includes the file management operations.

- **Open** for retrieving images from archives.
- **Save Images** for saving images to the Archives.
- **Film Images** for sending the selected images to MasterFilm.
- MasterFilm opens the Master Film application for viewing, rearranging, windowing and zooming images prior to sending them to be printed. (See Chapter 7 of this volume.)
- Queue Manager for inspecting, changing priority or removing copy transactions of image/series from one archiving device to another.
- **Logout** for logging out of the system.
- **Exit** for exiting the Study.



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Process menu lists the applications available on the Processing system. To activate an application, click on it. Each of the applications is explained in the chapters listed Viewer below: MPR Viewer - vol. 1, Chapter 5 3-D MPR - vol. 2, Chapter 2 Angiography MIP - vol. 2, Chapter 6 **3D** DentaCT **Angiography MIP** - vol. 2, Chapter 8 **DentaCT** vol. 2, Chapter 16 MasterMatch Master Match vol. 2, Chapter 15 Time Lapse - vol. 2, Chapter 4 Time Lapse - vol. 2, Chapter 3 Combine Images **Combine Images** Voyager vol. 2, Chapter 5 Voyager 4-D Angio - vol. 2, Chapter 9 4-D Angio **HeartBeat-CS** vol. 2, Chapter 14 **Functional CT** - vol. 2, Chapter 11 HeartBeat-CS vol. 2, Chapter 13 Q-CTA Functional CT vol. 2, Chapter 12 MasterLook Q-CTA Stereotaxis vol. 2, Chapter 10 "MRI Normalization MRI Normalization – MasterLook Operation Manual" Stereotaxis **Offline Recon** vol. 1, Chapter 3 **PinPoint** "PinPoint on the MRI Normalization Mx8000 CT User Guide" OffLine Recon (#T55B-2460) Tasks Tasks lists all the currently active applications, some of which may not be visible on the screen. MasterFilm The desired application can be brought to the Patient Catalog foreground by clicking its name in this menu. Study - ON LINE IMAGES -Study Doe John - active -

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Misc
Air Calibration
Tube Conditioning
Generate Protocols
Configuration
Impulse Response
Slice Width
Fix Patient Data
Voice Recorder
Auto Voice Control

Miscellaneous options include the following functions: Air Calibration, Tube Conditioning, Generate Protocols, Configuration, Impulse Response, Slice Width, Fix Patient Data, Voice Recorder, and the setting of the Auto Voice Control.

(See Chapter 3 of this volume for a description of the Misc menu.)

Service

Service Parameters Default Store Devices

XRT - Filament

XRT - Z-alignment

XRT - DFS alignment Phantom Calibration

HCOR

Save/Restore Tables

Analysis

Ring ID

Bad Detectors

Fee Bias

Show Temperature

Tube History

Print ROI

Recon Filter

Error Log Viewer

Error Log Online

System Monitor

Procmon Bugrep

Service Terminal

MCU Utilities

Most selections from the **Service** menu are reserved for use by Philips Service personnel only.

Bugrep and **MCU Utilities** can be used by system operators.

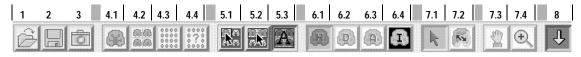
• Use Bugrep to report errors ("bugs") that may occur during system operation. Ask your service or applications person for instructions.



• Use MCU Utilities to reset the system after an "Emergency Stop" situation. (See procedure near beginning of Chapter 3 in this manual.)

Tool Bar

The standard **Toolbar**, located at the top of most windows, contains the following icons for activating the frequently used functions.



The buttons (from left to right) are:

- 1. **OPEN** opens the Archives Manager for selecting a different series of images for viewing.
- 2. SAVE ____ for saving the selected images in the Archives.
- 3. FILM for sending the selected images to the MasterFilm prior to printing.
- 4. Number of Images in the Viewer Window
 - **4.1. ONE-IMAGE** to display a single large image.
 - **4.2. FOUR-IMAGES** to display 4 images on one screen.
 - **4.3. SIXTEEN-IMAGES** to display 16 images on one screen
 - **4.4. DESIRED NUMBER OF IMAGES** allows the user to set any desired number of images.
- 5. Image Selection Modes:
 - **5.1. FRAME** to select one single frame.
 - **5.2. GROUP** to select a group of images. (When images from more than one series are displayed in viewer, clicking on any image within that group selects all images within that series.)
 - **5.3 ALL IMAGES** to select all the images in the Scan window.

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6. Windowing modes:

- **6.1. HIGHLIGHT** window for activating the highlight *window* range in addition to the normal one.
- **6.2. DUAL** window for activating the second *window* range in addition to the normal one.
- **6.3. ALTERNATE** window to switch from the normal window to the alternate one and toggle (alternate) between them.
- **6.4. INVERT** window to reverse the gray levels of the image, thereby displaying a negative of the image.

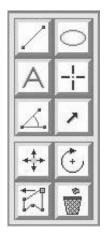
7. "Handling" of the Images

- **7.1. SELECT** to cancel graphic operations for enabling selection of images.
- **7.2. ENHANCE** to sharpen or smooth the edges.
- **7.3.** PAN for moving the selected images within the window.
- **7.4. ZOOM** for magnifying and minifying the selected images.
- 8. AUTOMATIC SCROLLING for switching ON/OFF the scroll of images that can pass (automatically) through the viewer. When clicked ON, each image scrolls in and out of the viewer (according to the number of images displayed) as quickly as it is reconstructed. The process is repeated until switched OFF. When clicked OFF, the scrolling process stops, without affecting the reconstruction process.

When the **Zoom** or **Enhancement** buttons have been clicked, an additional field is displayed (as in the example below) to allow monitoring and changing the zoom ratio or enhancement. Use the up or down arrow to the right of the field, or type in the desired value.



Graphic Tool Box



The **Graphics Tool Box** located on the right side of the Viewer window contains the graphical aids for annotating and measuring features on the images. It includes the following graphic elements:

- Line ____ straight, curved and freehand lines for length measurement
- ROI elliptical, rectangular, curved and freehand Regions Of Interest for measuring area, mean and standard deviation of the pixel values (pressing the right mouse button enables you to switch between the shape of the ROI)
- **Text** A for annotation on the images
- **Cursor** -i- for measuring pinpoint pixel values
- Angle _____ for measuring angles between features on image
- **Arrow** for pointing to features of interest

Operations on graphic elements are:

- for moving the selected graphic element
- Rotate for rotating the selected graphic element
- **Delete** for deleting the graphic element to the trash

For detailed operation instructions of the graphic elements, refer to **Chapter 6, Vol. 1 - Graphics**.

A pop-up menu, when invoked, appears on the image and can be used to activate the most commonly used functions and tools. To invoke this menu, place the pointer on any one of the images and click the right mouse button.

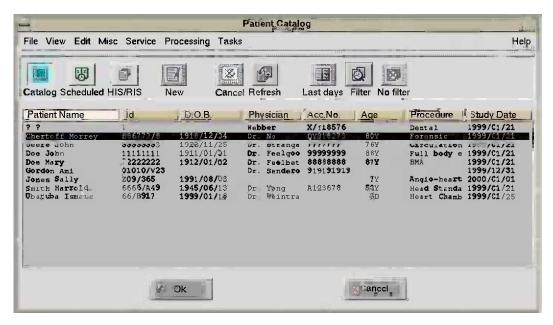
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Patient Catalog

The **Patient Catalog Viewer** is used for handling and managing the **Patient Catalog** database and for easy selection of a scanned patient. It is accessed

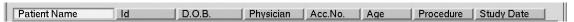
by clicking the patient **CATALOG** button in the Patient Data Screen. (See **Chapter 3**, **Vol. 1** – **Scanner Operation** for details on how to use the **Patient Catalog**.)

When the **Patient Catalog** is displayed, only those patients who have already been scanned will appear.



When the **SCHEDULED** button is clicked, only those patients who are scheduled to be scanned are displayed.

When opened, the Patient Name Column takes priority of the list (according to the alphabetical order of the patients' family names), although the order in which the lines are displayed can be arranged according to preference. At the head of each column is a button that, when clicked, rearranges the order of all the lines, according to that parameter.



If desired, click any of the other Column Head Buttons to rearrange the order of display. The following example shows how selecting the "Id" parameter has re-arranged the lines according to the patients' identification numbers.



All additional clicks on the same Column Head Button will reverse the displayed order of the lines (throughout the entire Patient Catalog), while keeping that parameter as the main priority.

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Menu Bar

The **Menu Bar** of the **Patient Catalog** consists of several menus which are described below:

- File Menu includes:
 - > New Patient... for adding a new name to the scheduled list
 - > **Delete** for deleting a selected line/s from the Patient Catalog
 - > Save Catalog... for saving the catalog in a file and to clear the catalog
 - ➤ **Logout** for leaving the system entirely
 - > Close for closing the Patient Catalog
 - **View** Menu contains a list of the Patient data fields. A selected item (marked by a yellow rectangle) is displayed in the Patients list.
 - Layout... displays a Dialog Box with the Patient Data Column Head parameters. From the Dialog Box, columns can be included or excluded from the Patient Catalog by selecting or deselecting those parameters.
 - > Filter... filters out non-relevant patient names for appearing in the Patient Catalog. Selecting Filter brings up the Filter Dialog Box. Entering any information in one, or more, of the parameter fields will allow the display (in the Patient Catalog) of only those patients whose parameters are identical to those entered in the dialog box parameter fields. "Identical," for this purpose, means in value, case, spaces and punctuation.
 - When a filtering process has been executed, a **FILTERED Button** appears in the Patient Catalog Toolbar. Clicking that button cancels the filter.
 - Last Days displays the patients that were scanned during the last X days (X is the number typed in the Last Days box); 0 displays all patients. After executing the Last Days option (a type of filter) the FILTERED Button will appear. Clicking the FILTERED Button will cancel the Last Days option and retrieve the full Patient Catalog display.

- **Processing** Menu lists the applications available on the system. To activate an application, click it.
- Tasks Menu lists all the currently active applications, some of which may not be visible on the screen. The desired application can be brought to the foreground by clicking its name in this menu.

Toolbar

The **Toolbar** buttons, in the **Patient Catalog**, appear with their names beneath them. The **Patient Catalog Toolbar** contains the following push buttons for activating frequently used functions:

✓ Note

Scheduled Patient lines will be deleted without requiring operator intervention!

- **SCHEDULED** displays the list of scheduled patients that were previously entered in the **New** Dialog box and were not scanned as yet.
- **HIS/RIS** opens the list of patients in the Hospital or Radiology Information Systems database for extracting the patient data to the Patient data form. Usually, the Scheduled list will be updated automatically by the HIS/RIS pushing patients into it.
- **REFRESH** displays the list of the previously scanned patients.
- **NEW** displays a Patient Entry Form for entering details of patients who are scheduled to be scanned. These patients will be included in the **Scheduled** list.

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• FILTER — identical to the Filter option in the View Menu (described earlier).

When a filter has been selected, the **No Filter** button will appear in the toolbar. It will remain until the filter is canceled, which is done by clicking the **No Filter** button.

- LAST DAYS identical to the Last Days option in the View Menu.
- Whichever button in the toolbar is clicked, it will be surrounded with a red border as a reminder of what is displayed in the viewer.
- CANCEL _____ stops the current Patient Catalog operation.

List Area

The List Area shows the patients' records for selecting. To select a patient, proceed as follows:

- 1. Click a record to select or deselect it.
- **2.** Click the **OK** button to bring the patient data into study.

Patient Entry Form

The Patient Entry Form is used to enter or modify the details of patients scheduled for scanning.

- To modify an existing patient record, from the Edit Menu select Modify. The changes will take effect for subsequent scanning only.
- To add a new patient to the Scheduled list, from the Toolbar, click the **NEW** button.

Gantry and Patient Table

The Gantry provides the support and means for rotating the X-ray tube, Beam Elements, Detectors, and Front End Electronics (FEE). The Gantry Panel is used to activate the laser marker, tilt the gantry, and control Patient Table movements.



Refer to $Chapter\ 1$, $Vol.\ 1$ - $Safety\ Guidelines$ for description of emergency procedures.

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Gantry Panel

The Gantry Panel controls and displays the Gantry tilt angle, Patient Table movements, alignment markers and safety system release. Buttons only light when their function is enabled.



- **TILT** buttons tilt the Gantry in the direction indicated by the arrows (in relation to the diagram on the button).
- TABLE IN/OUT and UP/DOWN buttons move the Patient Table in the respective directions. A high Patient Table value (255 maximum) represents a low position; whereas a low value (95 minimum) represents a high position.
- IN or OUT between the internal and external markers (exactly).
- MARKER ON/OFF buttons turn ON and OFF both the internal and external laser markers which are used for positioning the patient in the slice plane.

- PATIENT RELEASE (continuously pressed) moves the Patient Table (out and down) and Gantry (to Zero tilt) to positions for easiest patient release at the end of the scanning procedure. The Patient Table moves to its maximum distance from the Gantry and lowers to its minimal height. When the button is released before completing the process, all motion stops.
- **ZERO IN/OUT** display for resetting the IN/OUT display to zero.
- X-RAY ON indication light.
- STOP BUTTON There are two red Stop Buttons on the Gantry Front Panel, one on the left and the other on the right. Either button can be used to bring the scanner and Patient Table movements and X-ray generation to an immediate halt.

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Gantry Panel Display

The **Gantry Panel Display** is located at the center of the top of the Gantry. Its LED numbers represent real time values. Even during Stretcher Released movement (see next page), Horizontal values (on the Gantry Display) remain accurate in real-time, according to **Stretcher** movement (in or out).

These values are displayed at all times when the Gantry is ON:

• **Horizontal** (mm) – The further the Patient Table moves from the Gantry, the value rises positively. Negative values, that represent a proximity to the Gantry, are proceeded by a minus sign (-). Positive values, that represent a distance from the Gantry, are not signed.

Note

The **Horizontal Zero** value, from which positive and negative values are determined, is assigned to an arbitrarily designated position by the operator. There is no default Zero position.

- Vertical (mm) Patient Table height values appear as positive values, but actually represent negative values. Therefore, the "maximum" value of 255 represents the lowest position to the floor. Accordingly, the "minimum" value of 95 represents the highest positions from the floor (if tilt = 0, then maximum height is 107).
- **Tilt** (degrees) Both positive and negative values are preceded by their appropriate signs.

The values of the following parameters are only displayed when the scanner is ready for, and during a scan:

- **KV** (Kilo Volts)
- **mA** (milli-Amperes)
- S (Seconds)



Patient Table

The Patient Table moves the patient to the scan position through the use of the Gantry Panel controls. The operator then makes fine adjustments in preparation for the actual scan, still with the Gantry Panel controls. Movement of the Patient Table during the scan procedure/s is then controlled either from the Gantry Panel controls, or the Operating Station.

Normal release of a patient, following the scanning procedure is again controlled with the Gantry Panel controls. Rapid or Emergency release of a patient can be achieved by using any of the three Stretcher Release Bars (see Stretcher Release Bars below).

The Patient Table has four main components

- Main Patient Table Unit can move up or down, and in or out
- **Stretcher** can move independently in or out from the main Patient Table unit
- Elevator mechanism
- Three Stretcher Release Bars one on each side (two) of the Patient Table on the floor near the Gantry; one at the foot of the main Patient Table unit. When pressed, a release bar unlocks the Stretcher from the Main Patient Table Unit and enables free stretcher movement, in or out.

The table supports a maximum patient weight of 200 kg (440 lbs), evenly distributed. The table extensions can support a maximum weight of 30 kg (66 lbs).



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- For Safety purposes, the Stretcher Release Bar at the foot of the Patient Table acts as an Emergency Clutch of the main Patient Table unit, preventing dangerous outward movement.
- Even during Stretcher Released movement, Horizontal values (on the Gantry Display) remain accurate in real-time, according to **Stretcher** movement (in our out).

Patient Supports (Positioning Aids)

Overview

This chapter gives an overview of the available patient supports (positioning aids). Use the patient supports to position the patient safely and comfortably to prevent motion artifacts. The following patient supports are available.

- Head holders and table top extensions
- Supports and cushions
- Immobilization straps

Patient supports are prone to wear and tear. They must be replaced with original parts if they are dirty or damaged.



Warning

Do not use any positioning aids not mentioned in this chapter.

Non-original patient supports may cause danger for the patient through collisions with the Gantry. Image quality may also decrease.

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Head Holders and Table Top Extension

You can plug the accessories described in this section into the head end of the patient table.



Warnings

If a head holder or support does not engage securely, it can come loose causing injury to the patient

Make sure that the plugable positioning aids are seated firmly and securely engaged in the receptacle on the table top!

Plugable positioning aids must not bear weights of more than a specified value shown on the warning label.

Positioning aids must be used exclusively for their intended purpose: head holder only for positioning the head, table top extension only for positioning the feet.

Head/Arms Support for Abdominal Examinations

Provides relaxed, comfortable positioning of the head and arms for examinations of the abdominal region.

Not recommended for head or neck examinations.

The head/arms support is inserted into the Patient Table accessory support located at the head end of the patient table.

To insert, push the bracket at the bottom of the head/arms support into the Patient Table accessory support until it locks into position.

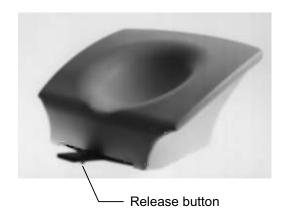
To remove, press the **RELEASE** button and pull the head/arms support out of the Patient Table accessory support.

The maximum supported load is 66 pounds (30 kg).



Warning

Using the head/arm support increases the risk that the Gantry might collide with the arms of the patient.



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Carbon-fiber Headrest

Radiolucent, metal-free head support, non-tiltable.

Position: 0°

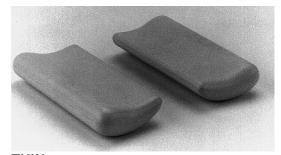
Material: carbon-fiber.



Head Side Cushions

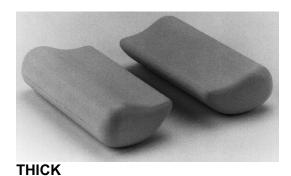
The head side cushions are placed on the right and left between the patient's ear and head support cushion. There are three cushion sizes: **Thin**, **Medium**, **Thick**.

With adult patients, the **Thin** head cushions ensure more certain and yet not unpleasant immobilization.



THIN

These **Thick** head cushions are used for children.



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Head Wedge Support

Wedge-shaped insert cushion for the carbon-fiber headrest.

Material: Polyurethane foam.



Coronal Head Holders (Optional)

The Coronal Supports are used for scans in a plane parallel to the plane of the patient's face.

There are two types of holders: **Prone** and **Supine**.

The patient lies with his head inclined backwards and the scanner is tilted to -30° with the prone holder, or to $+30^{\circ}$ with the supine holder.

The maximum supported load is 77.2 pounds (35 kg).



Coronal Prone Head Holder



Coronal Supine Head Holder

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Soft Straps

To immobilize the patient's head, attach the VelcroTM straps to the textured strips on the head holder (applies to both fixed as well as tiltable head holders), and guide them over the patient's forehead and chin.



Head Support Cushion

Provides relaxed and comfortable positioning of the head for examination of the body. It is used for feet first supine positioning of the patient.

Material: Bocollo foam.



Neck Support Cushion (Optional)

Insert cushion as additional padding for the tiltable headrest.

Material: Bocollo foam.



Table Top Extension

The table top extension is for the 195cm long table top.

It is used for **feet first** positioning of the patient. Examination up to the region of the thoracic spine is possible.



Wall Holder for Mattress

This item provides a convenient place to store the mattress when it is not in use.



Knee-leg Support

This support is used for reduction of lumbar spine curvature during lumbar spine examinations and for comfortable positioning of the patient's legs during all examinations.



Positioning Mat

Specially shaped positioning mat with PVC film coating and VelcroTM strap fastening for soft, comfortable positioning of the patient on the tabletop.



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Stabilizing Strap

This strap is used for stabilizing the patient in the positioning mat. Length: 150 cm.



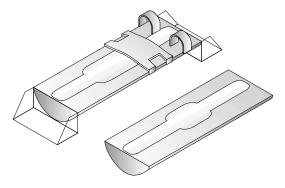
Paper Roll Holder Set

Spindle holder for paper rolls with two rolls for medical crepe (each 60 cm wide and 50 m long) for hygienic covering of the patient positioning mat.

Pediatric Cradle PCR (Optional)

The Pediatric CRadle (PCR) is to support children and infants during scans. The Plexiglas cradle with its semi-cylindrical shaped base comes with head restraints and arm/leg straps to restrain pediatric patients during scanning procedures.

- Position the cradle on the table top in such a way that the infant is centered.
- Do not use the table top mat.
- Maintain a distance of at least 10 cm between the region to be examined and the front edge of the table.
 - Scanning is only possible with the range marked with black lines on the table top.
- Immobilize the infant with the straps.





Make sure that the infant cradle cannot collide with the Gantry during table top movement.

X-Ray and Detection Systems

X-Ray Tube

The X-ray Tube, mounted on the Gantry, has a 6.5 MHU rotating anode with a variable focal spot size of 0.6×1.0 mm² and 1.1×1.5 mm².

X-Ray Power Supply

The X-ray Power Supply consists of the rotor-mounted DC-to-high-frequency inverters and the high voltage transformers. It is powered from the power cabinet through low-voltage slip-rings and controlled by the computerized High Voltage Control Unit.

MxView Diagnostic Console (optional)

The **MxView** is an independent diagnostic workstation that enables the physician to review and process clinical images without interfering with scanner operation.

The **MxView** is connected to the CT system through an **MxView** high speed data communication link.

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Scanner Operation

General

This chapter describes the following scan operation procedures:

- 1. Login and daily checks
- 2. Operation of Patient Table
- **3.** Scanning process
- 4. Ancillary functions

System Power-Up

- 1. For most systems, it is recommended to keep the system ON at all times. This applies to scanners that have facility-supplied cooling water or air conditioning 24 hours a day, 7 days a week.
- 2. However, for a scanner that does not have 24/7 cooling, gantry power must be turned OFF when cooling is not available, using the ON/OFF switch on the CT-Box.
 - When ready to resume scanning, switch ON the gantry and perform the Power-Up procedure below.
- **3.** If shut-down is necessary for maintenance purposes perform the system Shut-Down procedure on the next page.

To begin work for the first time, or to restart after a period of power-down, proceed as follows:

- **1.** Turn ON the ON/OFF switch located on the front panel of the computer desk cabinet.
- 2. Press the ON/OFF button of the O_2 computer through the slot in the front panel of the computer's cabinet.
- **3.** Turn ON the ON/OFF switch located on the front panel of the scan control panel.
- **4**. Login to the system by double clicking the Twin-7180 icon.
- **5**. Turn **ON** the multi-imager camera (camera is optional).
- **6.** Turn **ON** the air-conditioning system in the Scan Room.
- 7. Verify that the door of the Scan Room is closed.

- 8. As a safety test, press the STOP button on the Scan Control Panel. The STOP light on the Scan Control Panel should light up. Try to perform a scan. A message box should be displayed. Follow the directions on the screen. The STOP light on the Gantry panel should turn OFF. Try to perform a scan. It should work now.
- **9.** Repeat the same procedure with the **STOP** button on the Gantry front panel and on the Scan Control Panel on the Operation Station.
- **10.** Perform **Short Tube Conditioning** (use **Misc. Menu.**→**Tube Conditioning** →**Short T.C.**). The system automatically waits 10 minutes before allowing scanning. During this time, you may use the system archive, type in the next patient details, etc.
- **11.** Calibrate the system weekly using the "Air Calibration" function (use **Misc. Menu.**→**Air Calibration**). See procedure near end of chapter.
- **12.** Perform phantom checks as described in Appendix B.

- It is recommended to do the Calibration procedure once a week.
- If no scans have been performed for seven days or more, the long tube-conditioning procedure must be performed.

System Shut-Down

If shut-down is necessary for maintenance purposes, perform this system shut-down procedure.

To shut down the system, proceed as follows:

- 1. Select File from the main menu bar, and select Logout.
- **2.** Double-click on the **Shutdown** icon.
- **3.** Turn OFF the **ON/OFF** switch located on the front panel of the scan control panel.



Caution!

Never interrupt the electric current to the computer when it is ON. Doing so could cause damage to the computing system or to the software.

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Emergency Procedures

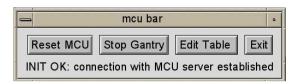
Emergency Stop

To bring scanner and Patient Table movements and X-ray production to an

immediate halt, press one of the three red **Stop** buttons. The buttons are located on the **Scan Control Panel**, one on the Operating Console, and two on the **Gantry Panel** (one on each side: left and right). The **Stop** lights on the Gantry panel light up when any one of the **Stop** buttons is pressed.

Reset from Emergency Stop

To return the system to normal operation, click on **Service** in the main menu bar, then click on MCU Utilities, at the bottom of the Service Menu. The following selection box will appear:



Click on **Reset MCU**. All red **Stop** lights should turn **Off** and Gantry lights will return, indicating Gantry is back on line.

Emergency Patient Release

If the patient's head is lying on one side of the Gantry opening and the trunk and legs are lying on the other side of the opening, the patient should be released in the direction of the legs.

If the head is likely to touch the roof of the Gantry opening, lower the head by removing the head support or the pillow, and turn the head to the side before moving the stretcher.

To release the patient **in the event of a power failure** or when the **STOP** indication lights up, proceed as follows:

If the patient can safely be pulled OUT, then:

- **1.** Grasp the handle at the foot of the stretcher.
- **2.** Apply pressure to one of the three Stretcher Release Bars and pull the stretcher out.
- **3.** Help the patient to dismount.

If the patient could more easily be pushed IN, push the stretcher towards the back of the Gantry and assist the patient to dismount.

In the event of a power failure or when the Stop indication is lighted, it is impossible to move the elevator of the Patient Table down. Therefore, it would be advisable to keep a stool or stepladder on hand.

Operating the Gantry Tilt and Table

To tilt the **Gantry**, to move the **Patient Table** or to switch the marker **On** or **Off**, press the appropriate buttons on the **Gantry Panel**. Drawings on the panels illustrate the direction of **Gantry** movement.

Patients weighing up to 308 lb (140 kg) can be examined without restriction.

Patients weighing up to 440 lb (200 kg) can be positioned on the table and examined, with the following advisories:

- Be especially careful when positioning heavy patients on the table.
- Before you start the examination convince yourself that the patient is not endangered either by the movement of the table or by the inclination of the **Gantry**.
- The stability of the **Patient Table** is not at risk but the correct functioning of the table (lift, positioning precision) cannot be guaranteed 100%.

When the patient is lying on the stretcher, with legs towards the **Gantry**, use the stretcher extension to support the patient's legs.

Use the Axial Head-Holder for axial head scans and the Coronal Head Holder (optional) for coronal head scans.

The extensions can support a maximum weight of 66 pounds (30 kg).

Use only soap and lukewarm water to clean the Patient Table, Stretcher, extensions and accessories. Strong detergents, alcohol and organic cleaners may damage the finish and also cause structural weakening.

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Patient Positioning in Gantry

Table Up/Down

To **vertically position the region to be scanned** (from the lowered position of the **Patient Table**, where the patient can sit, and then lay down on the Stretcher) in the Gantry opening, use the **Up** or **Down** buttons on the Gantry panel.

When adjusting height, the **Patient Table** makes an automatic full stop at the **125** value mark (the optimal height for scanning an average patient). To continue adjusting height, release the button and press again.

Table In/Out

To bring the patient's region of interest into the Gantry opening, use the **In** or **Out** buttons. When an **In** or **Out** button is continuously pressed, movement accelerates after about five seconds. For fine adjustments, press and release the button accordingly.

To **zero** the display of the Patient Table position at the beginning of the study,

press the button. Zeroing is recommended only after the patient was positioned, prior to the first scan. Do not reset the display values again during the study.



Warning!

When bringing an unrestrained child into the Gantry opening, be prepared to prevent the child from reaching out to grab the Gantry Panel (especially the Gantry Panel buttons).

The Patient Table cannot be moved IN when it is under a certain height. Raise the Patient Table UP to enable moving it IN.

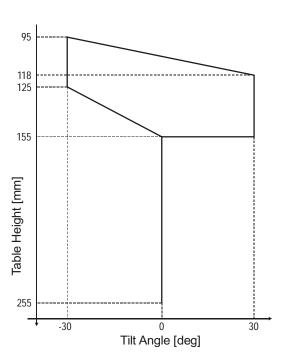
Gantry Tilt

To tilt the Gantry forward (+) or backward (-), press the respective buttons on the Gantry Panel.

The tilt range is from -30 to +30 degrees. 0 (zero) indicates that the Gantry is in the vertical position.

When adjusting tilt, the machine makes a full stop at zero tilt until the pressed button is released and pressed again.

In certain Patient Table heights, the normal tilt range is limited. Raise or lower the Patient Table to enable tilting.



Because of safety reasons, there is a "Safety Envelope" which limits the range of the **Tilt Angle** as a function of the **Patient Table** height. The illustration displays this envelope.

For example: from the lowest **Patient Table** height (255 mm) up to a height of 155mm, only zero tilt is available.

From a **Patient Table** height of 155 mm up to a height of 125 mm, the minimum available **Tilt Angle** is varied from zero to –30, while the maximum available **Tilt Angle** is +30 degrees.

From a **Patient Table** height of 125 mm up to a height of 118 mm, the minimum available **Tilt Angle** is -30 degrees and the maximum available tilt angle is +30 degrees.

From a **Patient Table** height of 118 mm up to the highest **Patient Table** height (109 mm), the minimum available **Tilt Angle** is -30 degrees, while the maximum available **Tilt Angle** is varied from +30 degrees to -30 degrees (the **Patient Table** height at zero degrees is 107 mm).

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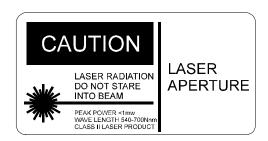
Marker

For precise positioning of the patient in the slice plane, press the



The slice plane is marked by a long and thin light-beam. The center of the Gantry opening is marked by shorter and thicker perpendicular beams on the top and sides of the body.

To turn off the marker, press the **Marker Off** button. If not switched off in this manner, the marker lights automatically turn off after about one minute.





Warnings

- Do not stare into the laser beam and instruct the patient not to stare into the beam.
- The use of optical instruments (e.g. eyeglasses with large diopter or mirrors) with this product will increase eye hazard.
- Ensure that, for head examinations, protective glasses are worn by the patient when the laser beams are on.

Patient Release

To **discharge the patient**, use the button on the Gantry Panel. Alternatively, bring the scanner to vertical by using the **Tilt** button and move the tabletop fully **Out** and then **Down**.

∽ Note

The Patient Table cannot be fully lowered when the Gantry is tilted. If the Gantry is tilted, zero the tilt to enable further lowering of the table.

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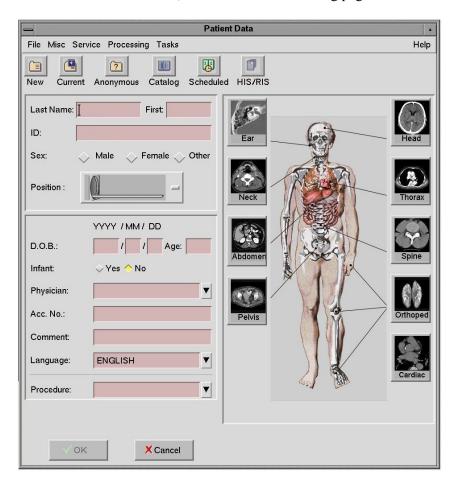
Scanning Procedure

Scan Control

The scanning process is initialized from the **Scan Toolbox** on screen and controlled from the **Scan Control Panel**. Refer to **Chapter 2**, **Vol. 1** - **System Description** for details.

Patient Data Screen

The following Patient Data screen is displayed. Proceed by entering patient data in the **Patient Data** Fields, described in the following pages.



Patient Data Fields

Entering information in the following patient data fields is mandatory:

- Name
- I. D.
- Sex
- Patient Position
- Infant

- Infant The operator must select the appropriate setting for the age of the patient. The default setting for the Infant button is "No." If the patient is a child up to 1½ years, the appropriate setting is "Yes."
- **Sex -** The "**Other**" option refers to **Anonymous** patients whose sex is anatomically unidentifiable. It may also refer to anything other than a living creature (e.g., minerals, phantoms, etc.)

All other fields are optional. After filling in the mandatory fields, either fill in additional (optional) fields or select a procedure, according to the following instructions, in order to continue with the scanning procedure.

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Patient Data Screen Buttons

New button opens a blank patient form (see above). After filling in the mandatory fields, the **Ok** and **Procedures Mini-Images** become active (not grayed-out) and may be clicked. The patient is automatically added to the **Scheduled** list.

Current button brings the details of the current patient (that was just scanned) to the parameter fields. It is used mainly to correct errors. Clicking **Ok** without selecting a protocol reloads the values of the previous procedure.

Anonymous button fills a preset subset of generalized patient details for unidentified patients (e.g., from road accidents). After clicking **Ok**, the **Protocol push buttons** become active and may be selected.

After the scan has finished, you may operate a utility for correcting Anonymous patient data retroactively in the Patient Catalog and in archives.

Catalog button opens the local Patient Catalog. If other catalogs are connected, they may be accessed from the Patient Catalog toolbar. A patient may be selected and its patient data sent to the Exam when Ok at the bottom of the Catalog list is pressed. The details are then displayed in the Patient Data Fields. After clicking Ok, the Protocol push buttons become active and may be selected.

Scheduled button activates the Patient Catalog with the Scheduled list open. A patient may be selected and his/her patient data sent to the Exam by pressing **Ok** at the bottom of the Scheduled list. The details are displayed in the Patient data fields. After clicking **Ok**, the **Protocol push buttons** become active and may be selected. After the first scan is performed, the patient data is transferred to the Catalog and erased from the Scheduled list.

HIS/RIS button (an optional feature) only appears in CT clinics which work with a DICOM Worklist Management Protocol. Clicking the HIS/RIS button opens a list of patients in the Hospital or Radiology Information Systems database who need to be scanned. It is used to extract the patient data to the Patient Data form. To transfer that data, select the patient's line in that list and click Ok.

Patient Selection

To select a patient, if the patient data exists on one of the devices, click on the device and select the patient.

To enter a New Patient:

1. The cursor will flash in the **Last Name** field. Type the last name of the patient to be scanned and press **Enter**.

Pressing **Enter** or **Tab** from within a field will move the cursor to the next field in the order. The cursor will flash and be ready for data input.

- **2.** Type the first name of the patient to be scanned and press **Enter**.
- **3.** Type the patient's identification number and press **Enter**.
- **4.** On the **Sex** parameter line, select an Option button to the left of either **Male**, **Female** or **Other** (as appropriate).
- **5.** Click the button on the right of the **Position** button. Select the desired patient position from the ComboBox. (Patient position is used for marking image annotations of Anterior/Posterior/Left/Right/Head/Feet.)

Note

The image labeling corresponds to the patient being positioned in an orientation as presented in the Combo Box. Therefore, for accurate results, use ONLY the supported orientations provided.

- **6.** The default setting for the **Infant** button is "**No**." If the patient is a child up to $1\frac{1}{2}$ years old, the appropriate setting is "**Yes**."
- **7.** Enter the rest of the patient's details, if desired (they are optional). "Physician" may be typed in or selected from the combo box list.
- **8.** Select the scan procedure according to the instructions on the following pages.

- To reach a field from anywhere on the screen, click inside the text box. After typing the data, press Enter; the cursor jumps to the next field. <Tab> also jumps between consecutive fields.
- Entering the date is done in the international format of yyyy mm dd (e.g., 1997 3 17).
- The value of the "Age" field can be typed directly. Alternatively, once the Date Of Birth is entered, the patient's age is automatically calculated.

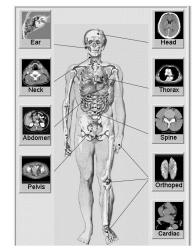
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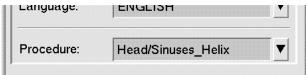
Procedure Selection

Only after the mandatory fields are filled-in, the **Ok** button and the **minimages** (that represent the Exam Procedures groups) are displayed in full color (previously grayed-out).

To select a procedure, you have three options:

- Click one of the **mini-images** to display the Exam Procedures of the anatomic regions.
- Click the arrow at the right of the Procedure field (the last field in the Patient Data Window fields) to select from a menu of available procedures in the ComboBox.





There, you can select from a preset list that includes the five most-used procedures and the last five procedures used.

• Type-in the desired procedure in the **Procedure** field on the **Patient Data** screen.

When patient data and procedure selection are satisfactory, click **Ok** to continue to the first scan of the procedure, which is usually a Surview scan.

An alternate way to enter new patient data is to select the patient's name from:

- the list of the previously scanned patients, or
- from the **Scheduled List**, or
- from the **Work List**.

This is accomplished by pressing the **Catalog** button, or the **Scheduled** button, or the **HIS/RIS** button respectively.

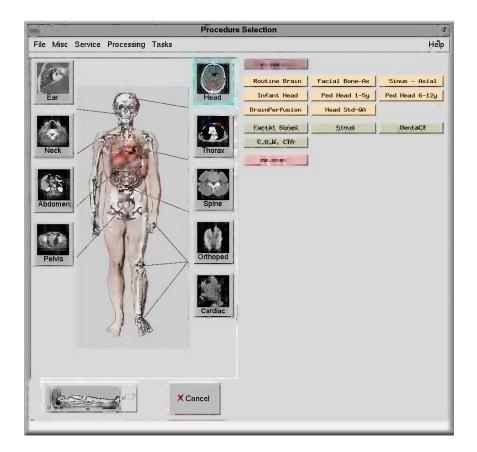
It is also possible to type in partial data, such as the access number or a partial name, and then to press on of the above buttons. Only the relevant patients' name(s) will be displayed.

The Exam Procedure may include:

- Optionally a Surview or a pair of orthogonal Surviews
- Plan on Surview (if Surview exists)
- Multi-protocol series of CT scans in Surview, Axial, and/or Helix modes.
- Multi-reconstruction
- Timing between scans and series and from external triggering device
- Save to archives
- Film Settings

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If a mini-image of an Exam Procedure group was clicked, Protocol Push Buttons representing the procedures for the selected anatomic area are displayed:



Each **Protocol** procedure will appear as a push button as follows:

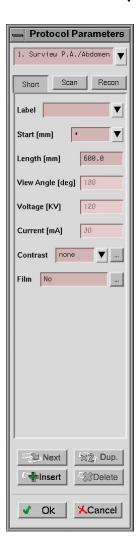
Protocol Name	Display Color
Surview	Purple
Axial	Yellow
Helix	Green
Multiple Protocol	Pink

Select the desired **Protocol** procedure appropriate to the case by clicking its push button.

When the cursor is placed on a Protocol push button, a short description will be shown at the bottom of the screen in the form of on line help.

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Surview Scan (for Plan on Surview)



After clicking the button of the applicable body region, representative images of the available preset procedures are displayed. Select the image corresponding to the procedure appropriate to the case.

If the first scan protocol in the procedure is Surview, then the Surview protocol (appropriate to the selected body part) is displayed.

1. Fill in and change the length in the Surview scan parameters protocol, if necessary. Usually a length larger than the needed one is defined in the procedure.

- In the **SHORT** mode, most of the parameters are grayed out and cannot be changed.
- To view the full set of parameters, and change the scan or reconstruction parameters, click either the SCAN Scan or RECON Recon tab button.
- It is also possible to change the archiving media from within the Reconstruction Protocol Parameters Window.
- 2. To continue to the CT slices, click **OK**Ok Cancel Closes the panel while restoring the values (that existed previous to opening the panel) and returns to the Procedure Selection screen.





3. When the initialization of the scanner is completed, it is ready to scan. The message shown at left will be displayed, and the yellow

Manual Scan button lights up on the Scan Control Panel.

4. Press the **Manual Scan** button to perform Surview.

The Surview image is displayed following the completion of the Surview Scan. In addition, the "Examination Flow" dialog box (shown at left) is also displayed.

(When the Surview image is displayed, you may save and film the Surview image, if desired.)

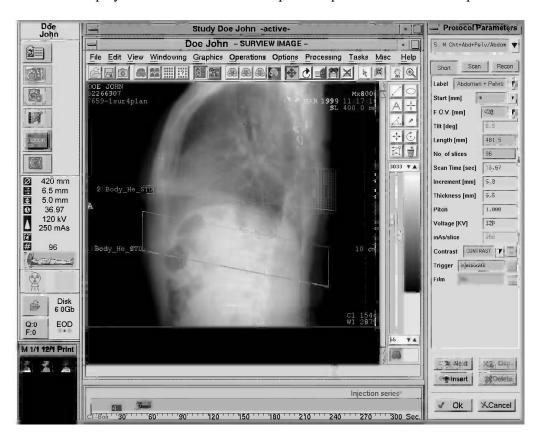
5. To plan the CT slices on the Surview image, click the Plan on Surview button on the Examination Flow dialog box. (More details about the dialog box are given later in this chapter.)

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Plan On Surview

The Plan Window

After the **Plan on Surview** button is selected, the following screen is displayed if the Surview scan is a part of a preset **Multi-Protocol** procedure:



If the Surview scan is not part of a preset Multi-Protocol procedure, select either an Axial or Helix Scan Protocol using the appropriate Protocol push

button. After the Protocol Parameters Window appears, click the button.



The **Plan on Surview Screen** will appear (as in the figure above) according to the parameters in the selected Protocol.

The **Title Bar** contains the name of the application. It is also used for moving the window by dragging it with the left mouse button pressed.

The **Current Executing Status** is displayed near the bottom right side of the screen within the frame of the active window.

The **Dialog Box** at the right of the Surview image contains the currently active scan protocol.

To view the full set of parameters and to change the archiving media, click either the Scan or Recon tabs at the top of the Protocol Parameters window. Clicking one of the three tabs will display the following parameters (see "Protocol Parameter Windows" for more details):

- Short Short This screen is always displayed first and shows only the most important parameters of the protocol. Their values are changed according to the manipulations of the lines on the Surview. Many of the parameters are grayed-out and cannot be changed (i.e. they are displayed for information only).
- Scan Scan displays and enables changes in the Scan Parameters.
- **Recon** Recon displays and enables changes in the **Reconstruction Parameters**.

If the executed Surview was a part of a preset procedure, a group of lines representing the next series of cuts appear on the Surview image. At the right of the image, the parameters of the series are presented in Short mode (see "Protocol Parameters Windows" for more details).

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- When the Plan button is clicked in the middle of performing the exam and there is a Surview in the Scan Viewer, the executed series (and part of series) are displayed. Functions such as, Next, Insert, Delete, and Duplicate work the same as during the initial planning stage, but only on those planned lines which were not yet executed.
- When the Plan button is clicked in the middle of performing the exam and there is no Surview in the Scan Viewer, or if more than one Surview scan had been executed, the last scanned Surview for this patient is displayed on the Plan on Surview Screen.
- During the execution of the plan the executed lines replace the planned lines on the **Surview** in the first frame of the **Scan Viewer**.
- If the patient moved on the table, click on the The present study is stopped and subsequent slices will not be marked on the **Surview** (which no longer represents the true patient location).
- To ensure accurate planning and execution, do not move the table Up-Down after the **Surview** scan.
- If the patient's position requires changing, reactivate **Procedure**

Selection by clicking the **Select Procedure** button Linear Change the **Patient Position** at the bottom of the window to correspond to the actual patient orientation on the table.

Plan Window Toolbar

The **Toolbar**, located at the top of the window, contains the same (icons) buttons as in the other Viewers (refer to **Chapter 5, Vol. 1** – **Viewer**), with the addition of five buttons devoted to planning.



The new buttons are:

- **1.** Move for moving the planned series to the desired region.
- **2. Rotate** for rotating the planned series to the desired tilt angle.
- **3.** Length for covering the desired length.
- **4. F. O. V.** for changing the reconstructed Field **O**f View.
- **5. Hide lines** for hiding the planned cuts and text (for viewing/filming/store). While operating, the button appears pressed and is flashing. To restore the lines, click the button again.

The four Format buttons that represent the Number of Images in the viewer window will be inactive (see **Chapter 5**, **Vol. 1 - Viewer** for more details).

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Defining the Position of a Scan Series

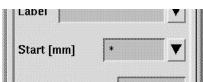
To define the position, coverage and angle of the series on the Surview image use the options on the **Toolbar**, located at the top of the window. Bring the pointer on the series lines and drag with the left mouse button pressed. The available operations are: **Move**, **Tilt** (**Rotate**), **Length** and **F. O. V.**

Alternatively, type a value or make a choice from the Pull-Down menu in the **Protocol Parameters** panel to the right of the Surview image to change the desired parameter(s) exactly. The available parameters are: **Start**, **Length** (or **No. of Slices**), **F. O. V.** and **Tilt**.

1. To move the series lines to the region to be scanned, select the

Move option from the Toolbar at the top of the window. Click and drag the lines so that the first line is at the desired start position of the series. Vertical motion will cause a change in the **Start** value (the position of the first slice of the series).

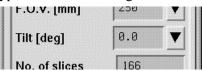
Alternatively, you can type the starting position in the **Protocol Parameters**.



2. To reach the desired CT plane angle, select Tilt from the

Toolbar . Click and drag the lines (on the image) to acquire the desired tilt angle.

Alternatively, type the desired tilt angle in the **Protocol Parameters**.

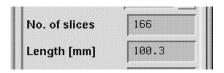


Tilt may be changed only on lateral (90°) Surview scans.

3. To cover the desired region length, select **Length** from the

Toolbar . Click and drag the mouse (on the image) to change the covered length. The number of the lines on the screen will be increased (or decreased, accordingly).

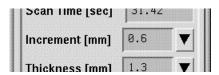
Alternatively, you can type the desired **Length [mm]** in the **Protocol Parameters**.



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4. To change the scan direction (e.g. to scan in the IN direction, not the usual OUT direction), select Length (or No. of slices) from the Toolbar. Click and drag the lines towards the first line and beyond; the number of lines will increase in the inverse direction.

Alternatively, you can insert a minus ("-") sign before the number in the



The increment field is inaccessible in the **Short Protocol Parameters** window. Typing a change in its value can only be done in the **Scan Protocol Parameters** window.

Increment box in the Scan Protocol Parameters.

- 5. To change the width of the covered region, select the F.O.V button from the Toolbar. Click on the image, and drag the mouse to change the covered width. The F.O.V field will be immediately updated. Alternatively, you can type the desired F.O.V. in the **Protocol Parameters** window.
- **6.** If you are working within a preset procedure (**Multi-Protocol**) proceed by performing step **a**. If you are **not** working within a preset procedure, proceed by performing step **b**.
 - a. To set the next series, click the preset series of the procedure is displayed. Manipulate it similarly to the first series. Repeat until all preset series are defined and then click the button to continue to the Axial scans.
 - **b.** To **set an additional series**, click the Procedure Selection Screen will appear. Select the desired procedure by clicking one of the **Protocol** push buttons. The insertion can be done either during or after completing the planning process.

- The scanner resources for the accumulated series including the present series are checked when clicking Next or Ok. If not enough resources are available, a dialog box describing the problem is displayed and prompts you on how to continue.
- The inactive series is marked by a light-green parallelogram which covers the scanned area. A thick line marks the first slice in each series. An orange colored "x2" or "x3" at the upper-right corner marks overlapping series.
- THE Next button is grayed-out at the end of the Multi-Protocol.
- 7. To add another series that was not originally part of the procedure, click the Duplicate button. A duplicated series will appear adjacent to the current series, with the same scan parameters. Manipulate it similarly to the first.

→ Note

When clicking **Duplicate**, all parameters except for text are duplicated.

- 8. To delete a planned series, select its sequence number from the drop-down list at the top of the **Protocol Parameters** and click the Delete button. The active series is erased and the previous series in the Plan becomes active.
- 9. To change any parameter (Start, Length, Text or archiving) of previously planned series, choose the desired series by its Seq. # and Title from the box on the toolbar, at the top of the window and manipulate it as above.

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☞ Note

All scan and reconstruction parameters can be changed in the **Scan** and **Recon Protocol Parameters**.

- 10. To change the Exam Procedure, click on Cancel, then click the button, and select as in the Procedure Selection above.
- 11. To set a text for the entire series, click inside the Label text box and enter text up to 14 letters.
- **12.** If a Surview or an exam that includes a Surview is selected, a dialog box appears which allows you to:
 - perform a Surview and plan on it, or
 - to use the present Surview for planning, followed by performing the CT scans.
- 13. To set the **Contrast** parameters, press the ____ button next to the **Contrast** field in the Protocol Parameters window.
- 14. To set the timing of the Scan (relative to the contrast injection), press the button, next to the **Trigger** field on the Scan Parameter window.

The **Timing Ruler** appears below the image, showing the number of scans that are timed, and the duration of each of the planned timed scans. If there is a problem with the scan setup, a message is displayed above the ruler, and the **OK** button is grayed out. To continue, adjust the parameters, e.g. delay, start, length, etc.

The inactive series is marked by a light green rectangle, bordering on the lower edge of the **Timing Ruler**.

The active series is marked by a red rectangle which appears on the **Timing Ruler**, higher than the inactive rectangle.

15. To set or change film parameters, press the ____ button, next to the Film field on the Scan Parameter window. (Follow the procedures for film parameters under "Common Protocols Parameters" later in this chapter.)

16. To exit without completing the plan, click the X Cancel button.



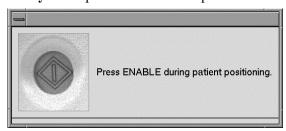
The Surview image with the Executed Slice lines (ES) is filmed and saved at the end of the study to the devices set in the Surview Protocol.

- While planning a preset procedure before the final series has been completed, the button is grayed out and cannot be clicked
- If you want to use only part of the scans from the procedure, you have to display them, using the button and then delete them with the button.
- To ensure accurate planning and execution, zeroing of IN-OUT readings of the **Patient Table** position will be blocked after the first scan (in this case, **Surview**).

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Scanning Workflow

1. After clicking ok at the end of Plan on Surview, the operator is prompted to press the Enable button to move the Patient Table and Gantry to the position of the first planned series.

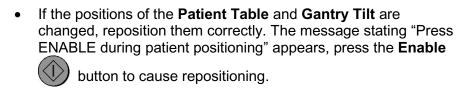


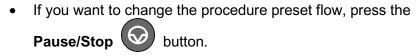
2. Press and hold the button on the Scan Control Panel to begin Patient Table and Gantry motions, while watching the patient. If the button is released, motions stop; pressing the button again resumes motions.

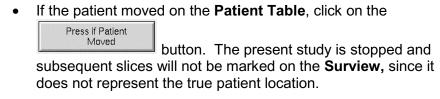


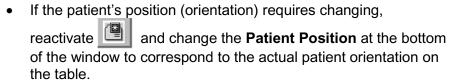
Warnings!

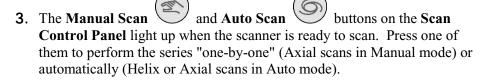
- While moving the Gantry and the Patient Table, keep the
 patient under continuous observation to avoid pressing the
 patient against the Gantry, or disconnecting the infusion or
 resuscitation apparatus.
- During studies, the Patient Table or Gantry movements are automatic. Make sure that there is enough clearance between the patient and the Gantry. Before initiating the scan, perform manual movements to check the clearance.











During X-ray production the following lights turn on:

- the yellow lamps on the **Gantry Panels**,
- the X-Ray Indicator Lamp on the Scan Control Panel, and
- the X-Ray indication on the Scan Status Display.



4. When working with **Axial** or **Helix/Concurrent mode**, the images are displayed.

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- Adjust the window CENTER and WIDTH for optimal viewing of the image.
- **Zoom and pan** the image to enlarge and center the image or the region of interest. Also, you may set the image to optimal size and move it with the mouse.

All subsequent images of the study will be zoomed to the same size when the "A" (All) button appears clicked.

To switch image scrolling through the viewer **ON/OFF**—press the

Automatic Scrolling button . When ON, each image scrolls through the viewer (according to the number of displayed images) as quickly as it's reconstructed. The process repeats until switched OFF, or until the reconstruction is complete. When OFF, the scrolling process stops, without affecting the reconstruction process.

If you perform a graphic operation during the image display (e.g., positioning of any graphical element like ROI, cursor, etc.), the Automatic Scrolling function is automatically switched to "OFF."

For detailed operation instructions on image manipulations and graphics refer to Chapter 5, Vol. 1 – Viewer and Chapter 6, Vol. 1 – Graphics.

- **5.** When working with **Evolving mode** (an optional feature), the images are displayed in a separate window, and are dynamically refreshed. You may adjust the window CENTER and WIDTH for optimal viewing of the image, to monitor the proper execution of the scanning process.
 - Upon completion of the scan, this window is replaced by a Viewer window, where all dynamic images are displayed.
 - **Zoom and pan** the image to enlarge and center the image or the region of interest. Also, you may set the image to optimal size and move it with the mouse.
 - Press **OK** to complete the Reconstruction.
- **6.** In timed, planned (triggered) scans, a delay is usually set between the injection start and the scan beginning. (See also "Trigger" in the "Helix Scan Parameters" section later in this chapter.) It is recommended, when possible, to set a delay of 10 seconds in the injector and the rest of the delay on the scanner; thus if there is any difficulty with the injection, the

injection may be aborted during the first 10 seconds and the scan will not start.

The Time Ruler at the bottom of the screen demonstrates the study progress.



\ Warning

When working with **timed planned scans**, observe the counter at the Timer Ruler: if it does not begin counting after the injection starts, or If the timer reaches zero and the scan has not initiated, press "Pause" to interrupt the system. Then, click "*" to get the last planned series displayed – this deactivates the timed mechanism for that plan. Finally, click OK and "Manual Scan" to initiate the scan.



- 7. Perform the rest of the scans in the series, using the **Manual**
 - Auto Scan Scan Control Panel.
- 8. To interrupt scanning, press the Pause/Stop button on the Scan Control Panel or select the button in the Scan Toolbox at the left side of the screen.
- **9.** When the series is completed, the **Patient Table** and **Gantry Tilt** are set for the next series.
- **10.** Press the **Enable** button on the **Scan Control Panel** to begin Patient Table and Gantry motions, while watching the patient. If the button is released, motions stop; pressing the button again resumes motions.
- **11.** The steps are repeated until the whole plan procedure is completed.

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Pause/Stop

If the **Pause/Stop** button is clicked, the **Examination Flow** dialog box opens, which enables changing the order of the procedure.

For detailed operation refer to the next paragraph. Examination flow

To change the scan parameters or the exam, click the



To end the exam, press **Stop Study**. The already performed scans are drawn on the Surview image.

In case you click the **Pause/Stop** button by mistake, press **Close to** exit **Examination Flow dialog box**.

Examination Flow

After a series has been terminated, a short version of the **Examination Flow dialog box** pops up to help the user continue the flow of scanning operations. The following functions can be chosen:

- to close the study
- to go to the next series (as planned in the protocol)
- to repeat scans
- or, to continue scanning

The **Press if Patient Moved** and **Plan on Surview** functions have been discussed in the pages 3-21 and 3-18 respectively.

Expanded Examination Flow Dialog Box

Clicking **Continue Scan** or **Repeat Scan** causes the Examination Flow dialog box to expand to full size, as shown at right.



Repeat Scan is used when a repetition of any type of scanning is desired: surview, axial or spiral.



Continue Scan allows you to continue an aborted axial or spiral scan, or to extend the same series by adding slices that may be necessary to cover the desired volume.

Use Default Values, or Enter Your Own

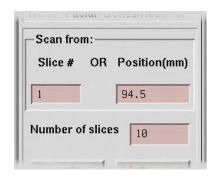
When you select **Continue Scan** or **Repeat Scan**, the system automatically provides default values for the table start position, slice number and 'Number of Slices.' Optionally, you can set either value to your desired parameter.



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Default values for "Repeat Scan:"

- **Slice # -** the number of the first image of the previous scan (usually 1).
- **Position(mm)** the start position of the previous scan.
- **Number of slices -** the number of images planned for the previous scan.



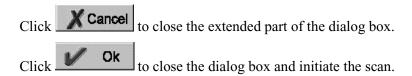
Default values for "Continue Scan:"

- **Slice # -** the number of the last image of the previous scan, incremented by one.
- **Position(mm)** the start position of the end of the previous scan, incremented by one.
- **Number of slices (aborted scan) -** the number of images necessary for completing the aborted previous scan.
- **Number of slices (completed scan)** if the previous scan was completed normally, default will be the minimum number allowed given the current scan/recon parameters.

Setting Your Own Value for Position or Slice Number

The default values provided in the dialog box can be overridden. Simply enter your own value in either the "Position" or the "Slice #" field.

- 1. When you enter a value in one of the fields ("Position" or "Slice #"), the value in the other field will be automatically calculated and updated.
- 2. The "Slice #" field is blanked out when entering a "Position" value that is not a position of a scanned image from the previous scan (except when the position is the "last image plus increment of one").



Scan Protocols

Protocol Selection

There are several Scan Modes:

- 1. **Surview** scans are radiographic-like scans upon which the study is planned.
- 2. **Axial** scans are the normal CT mode of slice-by-slice scanning while the **Patient Table** is motionless. The result is: **n** slice images (**n** is the product of the number of scans, and the number of slices/scan in the specific scanner, one to four in the scanner system).
- **3. Dynamic** protocol consists of a series of Axial scans, performed with preset timing, at a single **Patient Table** position or several discrete positions, for following the change in contrast wash-in/wash-out in the body tissues.

The above **Dynamic** protocol is different from the **Dynamic** Procedure which may include **Surview**, **Axial** or **Helix** scans and several **Dynamic** and **Continuous Dynamic** series with variable delays between them.

- **4. Helix** (spiral) scans are multi-rotational scans while the **Patient Table** is incrementing continuously; the result is a series of slice images, reconstructed at any desired increment.
- **5. Continuous Dynamic** is a multi-rotational scan without **Patient Table** increment for detecting fast contrast changes.

The **Scan Protocol Title** denotes the following:

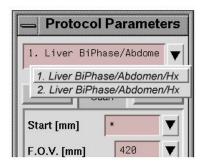
- **1.** Type of Scan:
 - Ax denotes the notation for Axial, (and Dynamic) scans
 - **Hx** denotes the notation for **Helix** scans
 - > Sv denotes the notation for Surview scans
- 2. If Adult, the line is blank. Otherwise, **Infant** is noted in the contents of the **Scan Protocol Title**.

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3. The format of the contents of the Scan Protocol Title is:

Scan Protocol Name/Scan Protocol Group/Protocol Type/Infant (if not Adult)

For example: Liver/Abdomen/Hx/Infant



As shown above, part of the title of the scan may be hidden. To see the entire title, click on the arrow to the right of the **Scan Protocol Title**.

Protocol Parameter Windows

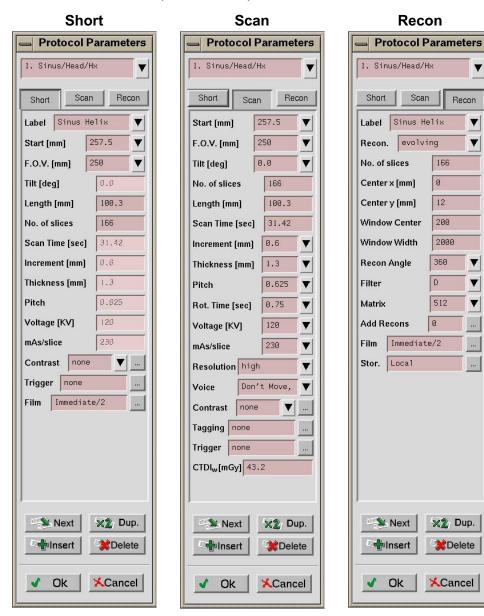
There are three potential **Protocol Parameter Windows** that appear to the right of all scan viewers. (Examples are shown on the next page.)

The **Short** Window is a step-saving feature that presents the operator with most of the parameters ready for a typical scan in the selected scan mode. Only six parameter fields are active (not grayed out) and available for changing.

Should you desire to change more parameters than those available in the **Short Protocol Parameters** Window, click either Scan or Recon and the **Scan** or Recon Protocol Parameters Window will appear in its place.

3

The specific **Protocol Parameters** Window will appear according to which of the three buttons (in the window) is clicked:



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Modifying Protocols

If the values of the **Protocol Parameters** do not suit the case requirements, modify them as follows:

- 1. Select the desired parameter for modification by either pressing the **Tab** key until its ComboBox is reached, or by directly clicking in its ComboBox with the left mouse button.
- **2.** Where an arrow appears to the right of a ComboBox, clicking that arrow will open a drop down menu of selections. Appropriate values may also be typed in a ComboBox, although not every box allows a full range of values. In that case, only those values displayed in the drop down menu will be accepted.
- **3.** Select or type a value in any of the boxes where the value should be changed. The cursor is by default inside the ComboBox, so that typing is enabled immediately.
- **4.** Click the arrow of the ComboBox whose value is to be changed and select another value from the displayed list. Alternatively, click inside the box and type the desired value.
- 5. To modify the current protocol during the scanning procedure, click on the Pause/Stop button, then click and change the parameters.

When all the parameters are set as desired, a delay of a few seconds occurs until the **Manual Scan** button lights up in yellow.

If the preset parameter values are changed frequently, replace them permanently with frequently used values. The parameter values can be changed in the **Generate Protocols** function.

Common Protocols Parameters

Parameters Shared by Surview, Axial and Helix Protocols

There are parameters that are shared by all three protocols in their various forms. These parameters, common to various protocols are described in this section. They will not be described again in the specific protocol sections.

Label

(Appears in **Short** and **Recon** modes)

This parameter is used to insert a label that will appear on all the images of the series. Any string up to 16 characters long may be typed in this field. The content of this field can also be ignored (it may remain blank, thus suppressing a label form appearing on the images). Alternatively, it may be selected from a predetermined list of labels.

Start [mm]

(Appears in **Short** and **Scan** modes)

The **Start** value denotes the **Patient Table** position for the first image in the scan series. The value in this box is copied from the **Plan on Surview**. If there is no plan, and a number is typed in the **Start Position** ComboBox, the **Patient Table** will be moved to this planned position during the scan process (while pressing and holding the **Enable** button). The **Start** position can be changed with a resolution of ½ mm. When an asterisk (*) appears, the scan will start from the "current" **Patient Table** position, which is taken from the Patient Table IN-OUT display when the scanner is in the "Ready for Scan" state.

F. O. V. [mm] (Field of View)

(Appears in **Short** and **Scan** modes)

The **F. O. V.** parameter denotes the diameter of the reconstructed image. The **F. O. V.** value is usually copied from **Plan on Surview**.where it is interactively set by the **F.O.V**. function The **F. O. V.** value can be selected from a ComboBox or typed directly in its text box in the range of:

- 100 to 500 for Standard resolution
- 100 to 500 for High Resolution
- 100 to 250 for Ultra High Resolution

The 250 mm F. O. V. is used for head, spine and infant scans. The 350 mm and 500 mm F. O. V. are used for body scans.

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Tilt [deg]

(Appears in **Short** and **Scan** modes)

The **Tilt** value (in degrees) denotes the **Gantry Tilt** angle for the planned scan. The value in this box is copied from **Plan on Surview**, where it is

interactively set by the **Rotate** function. If there is no plan, it is taken from the **Gantry Tilt** display when the scanner is in the "Ready for Scan" state. If the **Tilt** value is changed, the **Gantry** will tilt to the desired tilt angle before the scan start (while the **Enable** button is pressed and held). When an asterisk appears, the scan will be executed with the current **Gantry Tilt** Angle. The range for **Axial** scans is from -30° to +30° (see explanation on **Gantry Tilt**, in **Patient Positioning** section).

Length [mm]

(Appears in **Short** and **Scan** modes)

The **Length** is the region covered by the planned scan series. Although its value is usually derived from the plan, , where it is interactively set by the

Length function, it may be typed directly in the text box. After typing, its value is corrected automatically to remain consistent with the scan increment and thickness planned values. The Patient Table will be moved this length during the scan and the images will cover the length of the body that passes through the irradiated volume. The maximum length is 1,500 mm (59.1 inches).

Center X [mm], Center Y [mm]

(Appears in **Recon** mode)

Center X and Center Y set the Horizontal (X) and Vertical (Y) displacements, in millimeters (with resolution of 1.0 mm) of the reconstructed image relative to the center of the Gantry opening. They are used to center the region-of-interest in the image frame.

Usually, the Center X and Center Y values are copied from Plan on Surview

or where it is interactively set by the **Move** function. Values within the range of **±F.O.V./2** may also be typed.

A positive X displacement moves the image to the right and a positive Y displacement moves it up.

Voltage [kV]

(Appears in **Short** and **Scan** modes)

The Voltage parameter is used to set the voltage according to the absorption characteristics of the scanned body part.

Head and Infant scans (all Infant scans) are only performable with Medium (120 kV) or Low (90 kV) voltage. Low or Medium voltages improve contrast resolution in small and medium objects or bodies, and therefore are preferred for scanning infants and normal size patients respectively. On the other hand, a High voltage (140 kV) scan provides greater penetration in large objects and reduces the noise of the images.

Usually the voltage is 120kV. Infant patients may scanned with 90 kV and the body of heavy patients with 140kV.

Voice

(Appears in Scan mode)

The **Voice** parameter is used to select a pre-recorded message set: before the scan (e.g. "hold your breath") and after it (e.g. "you can relax now").

- Access Language selection from the Patient details dialog box.
- If the Preset protocol message is not relevant, (e.g. a non-cooperative patient) select None from the list box to cancel the message. If you select None from the Scan protocol dialog box, the voice message is disabled for the current scan only. If you select NONE from the Patient data dialog box, the voice messages will be disabled for the entire study.

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Contrast

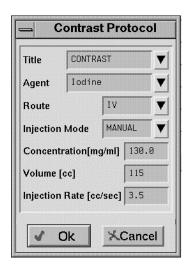
(Appears in **Short** and **Scan** modes)

The **Contrast** list box displays the contrast media to be injected into the patient. If the scan is to be done without injection, **none** is displayed. If contrast media is to be injected, the media type is displayed.

To switch between **Contrast**, and **Contrast none**, click the list box arrow next to **Contrast** in the **Parameter Protocol** window

To change the contrast type or to access additional injection parameters,

(including **Contrast** and **Contrast none**) click _____ next to the **Contrast** list box in the **Parameter Protocol** window). The following **Contrast Protocol** dialog box is displayed:



Type in or select the desired values in each **Contrast** parameter.

Additional Recon

Up to ten additional reconstructions with different parameters may be performed from the same Raw in continuity to the scan and immediately after the first reconstruction of all series is finished. The values in this line may be none or 1, 2, 3, 4, 5 or 10. To access and change Additional Reconstruction

parameters, click the ____ button

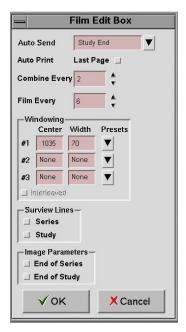
There are three priorities of the reconstruction queue: first priority is given to the first and last image of each sequence, second priority is given to the first set of image reconstructions and the third priority is given to the additional reconstructions.

Film

(Appears in **Recon** and in **Short** menus)

Reconstructed images can be sent immediately after display to MasterFilm.

To set the **Film** parameters click _____ next to the **Film** field. The following Film Protocol dialog box appears:



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Auto Send: Scroll to one of the following Auto Send options:

- None—Cancel Automatic Filming
- Immediate—Send to MasterFilm after reconstruction
- Study End—Send to MasterFilm at the end of the study
- Series End—Send to MasterFilm at the end of the series

Auto Print Last Page: Select the **Auto Print Last Page** check box to enable **Auto Filming** of the last page, even if the page is partially empty. (If this feature is enabled, all studies will start in a new page).

You can access the **MasterFilm Auto print** option from MasterFilm only.

Combine Every: Enter (or scroll to) the number of adjacent images you want to combine into thicker slices. Your options range from 1 to 25.

Film Every: Enter (or scroll to) a number that determines the make up of a partial image set. For example, if **Fuse Every** is set to 1, and **Film Every** is set to 3, every third image will be filmed. If **Fuse Every** is set to 3, and **Film Every** is set to 2, each set of three images will be fused and every second fused slice will be filmed. Your options range from every 1st to every 25th.

Windowing: You can select from 1 to 3 sets of **Width** and **Center** window settings for images that are being automatically sent to **MasterFilm**. You can:

- Enter your own values in the text boxes, or
- Scroll to preset Width and Center values, or
- Select **None** to not request a second or third windows setting.

- At least one windowing setting must be made, or Auto Filming will not occur.
- Windowing Presets include bone, lung, etc. Also, an asterisk
 (*) is selectable, which means that the image will be sent to
 the printer with its original (as acquired) windowing values.

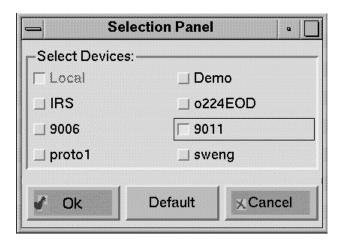
Surview Lines: The Surview image with the Executed Slices Lines (ES) can be automatically filmed for a single series or for an entire study.

Image Parameters: The **Image Parameters** frame can be automatically filmed for the last image of each series, or at the completion of a study (the last image in the last series in the study).

Stor. (Appears in Recon mode)

The **Image Storage** parameter is used to select the archive devices for storing the reconstructed image.

To change the archiving media (add/remove), click the ____ button (the next to the last parameter field). The following Dialog Box is displayed.



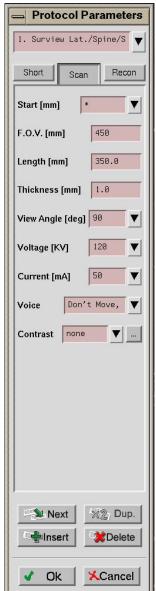
Local (local HDD) and any of the listed devices may be selected. (See **Chapter 4, Vol. 1 – Archives Manager** for more details).

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SURVIEW Protocol

Surview Scan Parameters

(see "Common Protocols Parameters" above for additional options)



Thickness [mm]

This parameter indicates that the collimation is set to 4x1 mm for Quad (2x1 mm for Dual) during the Surview scan.

The effective spatial resolution in the direction of the Axial Surview scan is 1.0 mm. It is set to this value and cannot be changed.

View Angle [degrees]

This parameter is used to set the angle from which the X-ray tube irradiates the patient during SURVIEW, analogous to conventional radiography. The two available viewing angles are PA (180°) and Lateral (90°).

Current [mA]

This parameter is used to set the X-ray current. Type the desired current in the range of 30 mA to 150 mA in adult protocol and 30 mA to 100 mA in infant protocol. You can also select from a predefined list with frequently used values.

Low current is advisable for smaller bodies to reduce the patient dose. A higher current setting is recommended for large patients in order to reduce the image noise.

Surview Reconstruction Parameters

(see "Common Protocols Parameters" above for additional options)



Weight

This parameter is used to set the strength of the edge enhancement on the Surview image. Four weights are available:

- **A** No enhancement, radiographic-like image
- **B** Little enhancement
- C Moderate enhancement
- **D** Pronounced enhancement (recommended)
- **E** Maximum Enhancement

Matrix

This parameter is available with values of 340, 512, 768, 1024 (768 and 1024 are optionally available). For Surview scans, the 512 Matrix is recommended.

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Axial Protocol



Axial Scan Parameters

(see "Common Protocols Parameters" above for additional options)

Thickness [mm]

Use the **Thickness** parameter to set the tomographic thickness, which determines the spatial resolution in the axial direction (perpendicular to the plane of the slice). Select the desired combination of collimation and reconstruction from a string in the ComboBox. The available options of Slice Thickness are:

	Main	Sub-Menu Items		
	Menu Item	# Slices x Thickness	# Slices x Fused Thickness(es)	
	2 x 0.5*	2 x 0.5	1 x 1 F	
Q	4 x 1	4 x 1	2 x 2 F, 1 x 4 F	
U	4 x 2.5	4 x 2.5	2 x 5 F, 1 x 10 F	
Α	4 x 5	4 x 5	2 x 10 F	
D	2 x 8	2 x 8	1 x 16 F	
	2 x 10	2 x 10	1 x 20 F	
	2 x 0.5*	2 x 0.5	1 x 1 F	
D	2 x 1	2 x 1	1 x 2 F	
U	2 x 2.5	2 x 2.5	1 x 5 F	
Α	2 x 5	2 x 5	1 x 10 F	
L	2 x 8	2 x 8	1 x 16 F	
	2 x 10	2 x 10	1 x 20 F	

^{*} optional

Fused Thicknesses are recommended to minimize partial volume artifacts.

The **0.5 mm** and **1.0 mm** Slice Width values are used for high and ultra high resolution scans (e.g. ears). The **2.5 mm** Slice Thickness is used for the base of skull and posterior fossa scans (to minimize partial volume streaks due to small, high-contrast bone structure) and for cervical and lumbar disk scans.

The **5 mm** and **8 mm** Slice Thickness values are used for standard scans of the brain, body and spine. The **5 mm** and **10 mm** Slice Thickness values are used when large coverage and high speed are necessary.

Increment [mm]

The **Increment** parameter is used to set the distance between two consecutive scans in millimeters. Entering "**Auto**" (or selecting it from the ComboBox) will set the motion to the sum of the Slice Thickness achieved in one scan. For example, if a thickness of 2 x 10 is selected and "**Auto**" is entered, the patient moves 20 mm between adjacent scans.

Entering a minus sign ("-") before the **Increment** value sets the **Patient Table** increment towards the **Gantry** (IN). When working with plan, changing the sign before the increment will change the location of the start and the last slice position, without changing the area covered by the series. Any desired **Increment** is allowed between +20.0 and -20.0 times the sum of the Slice Thickness achieved in one scan, with resolution of half of one millimeter. When the Thickness value is changed, the increment is set automatically to the sum of the Slice Thickness achieved by one scan, unless it was zero. In that case, the **Increment** value remains set at zero, i.e., there will be no Table motion between adjacent scans.

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Scan Ang [deg]

The **Scan Angle** parameter is used to set the angle of the data acquisition. The operator may select an angle from the following ComboBox:

- 240°
- 360°
- 420°

Solution Solutio

Selection of the 240° scan angle is not performable when High or Ultra-High resolution is selected in the Scan Protocol.

A 240° **Scan Angle** is a partial scan that enables fast (0.33, 0.5, 0.67 second) scan. The most common scan modes are 360° and 420° , where the 420° contains the 60° overscan which helps to attenuate patient motion artifacts.

Cycle Time [sec]

The time duration between adjacent scans.

Rotation Time, Scan Angle, and **Slice Increment** affect the minimal **Cycle Time**.

mAs

The **mAs** [mAs] parameter sets the exposure value during the scan. It is determined by the Tube Current and by the Scan Time. The Scan Time is determined by the Rotation time and by the Scan Angle.

A larger mAs factor decreases the image noise and enhances the contrast resolution but increases the radiation dose the patient receives and the X-ray tube loading.

When the scan time is changed, the software changes the current in such a way to keeps the mAs constant (up to the tube and generator power limitations).

Rot Time [sec]

The **Rotation Time** [sec] parameter defines the duration of one rotation of the rotor. This is a discrete parameter selectable from the list:

- 0.5 second (optional)
- 0.75 second
- 1 second
- 1.5 seconds
- 2 seconds

If either a High or Ultra High resolution mode is selected, then 0.5 second is not available.

Resolution

Three **Resolution** modes are available:

- Standard and Ultra-Fast with a resolution of up to 12 line pairs/cm;
- **High** with resolution of up to 16 lp/cm (e.g. for lungs studies)
- **Ultra-High** resolution with up to 24 lp/cm (e.g. for ear and orthopedic studies)

Standard, Ultra-Fast and **High** resolution scan modes are available within an F. O.V. of up to 500 mm. **Ultra-High** scan mode is available within an F.O.V. of up to 250 mm.

High and **Ultra-High** resolutions are available with rotation times longer than 0.5 second.

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No. of Slices

The **Number of Slices** parameter is used to set the number of scans that will be performed in the sequence and also indicates the remaining number of scans during the study.

In **Automatic Scan** mode, the scanner stops after the set number of scans has finished. Similarly to Increment, this parameter is superseded by the value planned on the Surview.

The number of scans is automatically determined by the **No. of slices** per series, and by the **No. of slices** per scan, e.g. for 4 X 2.5, and for 20 slices per series, the number of scans is five.

Gating (optional feature)

In an **Axial** series, the **Gating** parameter is used to trigger the radiation according to a mechanical event.



Setting the **ECG** parameter to "yes" allows making an adjustment or compensation for the heart cyclical mechanical event. (**Chapter 2 - Axial Prospective Gating** of the Mx8000 Cardiac Gating Options Manual describes setting the ECG parameter.)

Setting the **Pedal** parameter to "yes" allows the clinician to perform scans from within the gantry room, using a foot pedal and a remote monitor. This enhances the ability to perform interventional procedures. (Enabling the Pedal parameter is described in **Chapter 9**, **Vol. 1 - Continuous CT**.)

CTDI_w [mGy]

The CTDI_w [mGy] parameter gives the average dose over the volume scanned for the set of the scan parameters defined within the protocol. The dose for the patient depends on the Voltage, mAs, Slice Thickness, Slice Increment and the Scan Length. It is displayed for reference only and cannot be modified.

Note

The **Angular Sampling** is automatically determined as a function of the **Rotation** and the **Resolution**.

- For Standard: it is set to
 - Normal for a Rotation Time of <= 1.5 seconds, and
 - **High** for 2.0 seconds.
- For **High** and **UltraHigh** resolutions it is set to
 - Normal for a Rotation Time of <= 1.0 seconds, and
 - **High** for >= 1.5 seconds.
- This parameter is displayed only as part of the **Image Parameters**.

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Axial Reconstruction Parameters

(see "Common Protocols Parameters" above for additional options)



Recon.

The **Reconstruction** parameter is used to determine if image reconstruction will be performed in one of the following modes:

- 1. **concurrent** reconstruct the first and the last image of the series with high priority. After the first image is reconstructed, reconstruct the previous sequence images.
- **2. on line** full quality reconstruction after each scan, before the next scan is enabled.
- 3. none without reconstruction

 The raw data is automatically stored in the IRS disk. After the scan is finished it should be reconstructed by the Off-Line Reconstruction function.

 The scan cycle is generally shorter with Concurrent or none reconstruction modes. However, during scans with these modes, the currently performed scans cannot be monitored.

Window Center, Window Width

Window Center and Window Width are used to set the gray levels of the displayed image.

Filter

The **Filter** parameter is used to set the mathematical algorithm which determines the sharpness or smoothness of the image. The noise (and sometimes the streak artifacts) in the image increase as the sharpness of the image increases, and vice versa. In general, the low contrast resolution decreases as the spatial resolution (and the image noise) increases.

The available filters are as follows:

- A. Smoothing Filter.
- B. Normal filter for body and base of skull scans (adapted to relatively low resolution images, acquired in relatively noisy conditions: large patient, thin slices, low mAs, etc.). Head: posterior fossa.
- C. Medium-sharp filter for body and base of skull scans (adapted to medium resolution images, acquired in relatively medium noisy conditions). Head: posterior fossa.
- D. Sharp filter for all scans (the "Highest Resolution" of Standard Resolution scan mode). It may be used for bone imaging when the soft tissue image quality is also important, and for that, high mAs are required.
- E. Ultra-sharp filter for high and ultra-high resolution scans.
- EB. Normal Standard Resolution filter for upper brain scans, with optimal homogeneity correction, improved bone-brain interface (edge enhancement filter).
- EC. Medium-sharp Standard Resolution filter for upper brain scans, with optimal homogeneity correction, improved bone-brain interface (edge enhancement filter). It is also used for enhancing neck scans.
- L. Sharp High Resolution body scans filter, optimized for thin slice Lung.
- F. Medium Sharp High Resolution body scans filter, optimized for thin slice Body.

Available Filters	Standard Resolution	High Resolution	Ultra-High Resolution
Head Filter	A, B, C, D, EB, EC	A, B, C, D, E	A, B, C, D, E
Body Filter	A, B, C, D	A, B, C, D, E, L, F	A, B, C, D, E

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3

☞ Note

The high and low contrast resolution of the image are determined by the full set of scan reconstruction parameters, especially by the Resolution mode and by the Filter, i.e. the smoothest Filter is **A**, and the sharpest Filter is **E**, but Filter **A** of the Standard (and Ultra Fast) Resolution is smoother than Filter **A** of the High Resolution, which is smoother than Filter **A** of the Ultra High Resolution mode. This also applies to other filters.

Matrix

The **Image Matrix** parameter is used to set the number of pixels that the reconstructed image will contain. Four options for matrices size are available: 340^2 , 512^2 , 768^2 and 1024^2 (768^2 and 1024^2 are optionally available).

Body images scanned in F. O. V. > 250 mm and Ultra-High resolution scans have to be reconstructed in the matrix size of 512^2 or greater, to retain full resolution and be free of most fan artifacts.

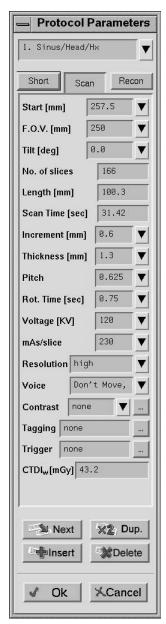
Head, spine and small body scans may be reconstructed in the 340² matrix with no loss of resolution. The smaller matrix has the advantages of faster reconstruction and smaller archive space for storing the reconstructed image.

When the F. O. V. is increased to more then 250 mm or the resolution increased to Ultra-High, the image matrix is automatically set to 512^2 if it was previously less than 512^2 .

Higher matrices (768^2 and 1024^2) are needed for Ultra-High resolution images (e.g., ear) with F.O.V. > 125 and for High resolution body images with F.O.V. > 250 in order to display the full spatial resolution.

Helix Protocol Helix Scan Parameters

(see "Common Protocols Parameters" above for additional options)



The Slice Thickness, Scan Time, Slice Increment, Pitch, Recon Algorithm, Number of Slices and the Maximum Scanable Length are usually inter-dependent. Any change in one parameter causes a change in various others.

Tilt [deg]

The **Tilt** parameter displays the **Gantry Tilt** during the scan. Usually the value which appears is copied from **Plan on Surview** or, if there is no plan, it is taken from the **Gantry Tilt** display when the scanner is in the "Ready for Scan" state. If the Tilt value was changed, the **Gantry** will tilt to the desired tilt angle before the scan begins (while pressing the **Enable** button).

Tilt angles are limited for helix scans when the couch direction is toward the gantry. A warning message appears if the desired tilt angle is not allowed.

Maximum Allowed Tilt Angles				
Couch	Scan Type			
Direction	Helix	Axial		
OUT (Away from Gantry)	-30° to +30°	-30° to +30°		
IN (Toward Gantry)	-7° to +7°	-30° to +30°		

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In **Helix** scans, increasing the tilt angle tends to decrease image quality. Thus, when considering image quality, use thinner slice thickness when scanning at increased tilt. The table below shows the recommended maximum tilt angles for various slice thicknesses.

Max. Recommended Tilt Angles (Helix Scans)					
Keep Tilt Less Th	Keep Tilt Less Than ► 5° 10° 20°				
For These Thicknesses ► (Helical Scans)	QUAD	4 x 5 2 x 10 1 x 20	4 x 2.5 2 x 5 1 x 10	4 x 1 2 x 2 1 x 4	
	D U A L	2 x 5 1 x 10	2 x 2.5 1 x 5	2 x 1 1 x 2	

Length [mm]

The **Length** parameter gives the region covered by the Helix. Usually, the value in this box is copied from **Plan on Surview** but the operator can type any desired value in the correct resolution and range. If the typed value is out of range, e.g., the time that is needed to execute is more than the scanner limitation, a message is displayed.

Thickness [mm]

The tomographic **Thickness** is the spatial resolution in the **Z** direction (the FWHM of the sensitivity profile, measured along the axis perpendicular to the image plane of the slice). This is a discrete parameter that can be selected from the ComboBox. The values in the ComboBox are based on the basic (Axial) Thickness, multiplied by factors that are determined by the current Pitch and by the available reconstruction algorithms for this Pitch.

Increment [mm]

The **Increment** parameter is used to set the distance between two consecutive reconstructed slices in millimeters. The value can be entered by typing or selecting an option from the ComboBox. If the **Auto Normal Quality** option is selected, the Increment will be set as equal to the Slice Thickness. If the **Auto High Quality** option is selected, the Increment will be set as equal to **half** of the Slice Thickness.

When working with **Plan**, entering minus ("-") before the increment, sets the **Patient Table** increment towards the **Gantry** (IN). This is possible only if the scan was planned on **Surview**. Changing the sign before the increment will change the location of the start and the last slice position, without changing the area covered by the series. Any desired increment is allowed between **-10.0 times the Slice Thickness** and **10.0 times the Slice Thickness**, with a resolution of **one-tenth of one millimeter (0.1)**.

Pitch

The **Pitch** parameter represents the value of the Patient Table's speed (this is a normalized speed: the motion of the table in multiples of total thickness for one rotation of the Gantry). It can be selected from the ComboBox or entered in the text box. For the Quad, the pitch is in the range of 0.25 to 1.75, in increments of 0.025; for Dual the range is 0.375 to 1.75, in increments of 0.005.

A larger **Pitch** enables a longer total coverage for a given scan time but (generally) produces a lower quality image (in terms of image noise and occasionally spatial resolution).

The **Pitch** values in the ComboBox are recommended from an image quality perspective. If the Ultra High resolution mode is selected, then a **Pitch** value greater than 1 is not available.

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Scan Time [sec]

The **Scan Time** [sec] parameter gives the total time of the scan.

The **Scan Time** value depends on the **Scan Length**, **Slice Thickness**, **Rotation Time** and **Pitch** available in the protocol. Its displayed value is for reference only and cannot be changed in this field.

mAs/slice [mAs]

The **mAs/slice** parameter sets the exposure during the scan. It is determined by the **Tube Current** (linearly), by the **Rotation Time** (linearly) and by the **Pitch** (inversely proportional).

To **change the mAs/slice**, select a value from the ComboBox or type a value within the range displayed there. If you type a mAs/slice that is not available by changing the current, then the nearest value from the list (in the ComboBox) is set.

No. of Slices

The **Number of Slices** value is derived from the **Sequence Length** and the **Scan Increment**. If the Number of Slices is set by the user, the Sequence Length is derived from this value and from the Scan Increment.

Rot Time [sec]

The **Rotation Time** [sec] parameter defines the duration of one rotation of the rotor. This is a discrete parameter selectable from the list:

- 0.5 second (optional)
- 0.75 second
- 1 second
- 1.5 seconds
- 2 seconds

If either a High or Ultra High resolution mode is selected, then 0.5 second is not available.

Resolution

Three **Resolution** modes are available:

- **Standard** and **Ultra-Fast** with a resolution of up to 12 line pairs/cm;
- **High** with resolution of up to 16 lp/cm (e.g. for lung studies)
- **Ultra-High** resolution with up to 24 lp/cm (e.g. for ear and orthopedic studies)

Standard, Ultra-Fast and **High** resolution are available with F. O. V. of up to 500 mm. **Ultra-High** is available with a resolution of up to 250 mm.

High and **Ultra-High** resolutions are available with rotation times longer than 0.5 second.

Trigger

The **Trigger** is used to generate a timing mechanism. The user determines the desired delay before the start of the scan, counting from the beginning of a selected event. If the contrast injection serves as the trigger, the radiation will not start until after the desired delay has elapsed.

- The Trigger can be operated manually or automatically. ("SAS"

 Spiral Auto Start is the option that enables the automatic operation of the scans.)
 - In the Manual mode of operation, the operator must press the auto scan button at the same time the injection starts.
 - In the Automatic mode, after the operator presses the auto scan button, the scanner continues to wait for a triggering signal from the contrast injector. The "count down" of the delay before scanning (see also note 3) begins immediately following the triggering signal from the contrast injector.
- 2. Up to 5 adjacent helix scans can be synchronized to a specific event (e.g., injection).
- **3.** a) The maximum delay between the injector's trigger and the beginning of the first scan is 300 seconds.
 - b) The maximum delay between the injector's trigger and the beginning of the last scan is 500 seconds.

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Warning

Keep the patient under continuous observation. Between the series, the bed will move automatically until completion of the plan.

Tagging (optional feature)

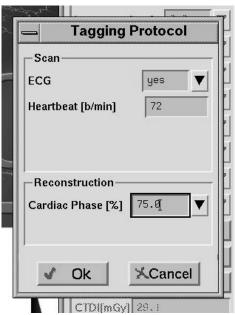
In a **Helix** series, the **Tagging** parameter is used to make an adjustment or compensation for a cyclical mechanical event, e.g. heartbeat, of the patient by selective use of the data.

The **ECG** parameter* is used to enable a recording of the event into RAW data, during the scan.

* The ECG parameter is enabled with the Helical Retrospective Tagging option, described in Chapter 3 of the Mx8000 Cardiac Gating Options Manual.

The **Initial Heart Rate** parameter gives the operator the option to store the patient's heart rate as measured (using the external ECG monitor) just before the scan.

The Cardiac Phase (%) parameter is used to designate the relative percentage location of the time period used for the reconstruction within the heart cycle.

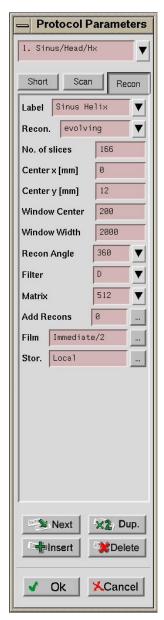


CTDI_w[mGy]

The $CTDI_w[mGy]$ parameter in a helical scan gives the average dose over the volume scanned for the set of the scan parameters defined within the protocol. The dose for the patient depends on the Voltage, mAs/slice, and the Slice Thickness. It is displayed for reference only and cannot be modified.

Helix Reconstruction Parameters

(see "Common Protocols Parameters" above for additional options)



Reconstruction

The **Reconstruction** parameter is used to determine if image reconstruction will be performed in one of the following modes:

- **1. concurrent** reconstructs the images (in final quality) in parallel to the scans: the first and the last image of the scan with high priority (the last image is marked as such).
- 2. evolving *- reconstructs as many images as possible with low quality (for monitoring the scan). After the scan finishes, all the images will be reconstructed with a good (final) quality.
- **3. evolving only*** reconstructs as many images as possible with low quality (for monitoring the scan). After the scan finishes, the images will <u>not</u> be reconstructed automatically with a good quality.
- **4. none** without reconstruction. The images should be reconstructed later using the BATCH RECON function.
 - * evolving is an available option

The scan cycle is generally shorter when using the Concurrent or Off-line reconstruction mode. However, during scanning in these modes, the currently performed scans cannot be monitored.

Window Center and Window Width

Window Center and Window Width are used to set the gray levels of the displayed image.

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Filter

This parameter is used to set the mathematical algorithm which determines the sharpness (or smoothness) of the image. The noise (and sometimes the streak artifacts) in the image increase as the sharpness of the image increases, and vice versa. In general, the low contrast resolution decreases as the spatial resolution (and the image noise) increases.

The available filters are as follows:

- A. Smoothing Filter.
- B. Normal filter for body and base of skull scans (adapted to relatively low resolution images, acquired in relatively noisy conditions: large patient, thin slices, low mAs, etc.). Head: posterior fossa.
- C. Medium-sharp filter for body and base of skull scans (adapted to medium resolution images, acquired in relatively medium noisy conditions). Head: posterior fossa.
- D. Sharp filter for all scans (the "Highest Resolution" of Standard Resolution scan mode). It may be used for bone imaging when the soft tissue image quality is also important, and for that, high mAs are required.
- E. Ultra-sharp filter for high and ultra-high resolution scans.
- EB. Normal Standard Resolution filter for upper brain scans, with optimal homogeneity correction, improved bone-brain interface (edge enhancement filter).
- EC. Medium-sharp Standard Resolution filter for upper brain scans, with optimal homogeneity correction. improved bone-brain interface (edge enhancement filter). It is also used for enhancing neck scans.
- L. Sharp High Resolution body scans filter, optimized for thin slice Lung.
- F. Medium Sharp High Resolution body scans filter, optimized for thin slice Body.

Available Filters	Standard Resolution	High Resolution	Ultra-High Resolution
Head Filter	A, B, C, D, EB, EC	A, B, C, D, E	A, B, C, D, E
Body Filter	A, B, C, D	A, B, C, D, E, L, F	A, B, C, D, E

The high and low contrast resolution of the image are determined by the full set of scan reconstruction parameters, especially by the Resolution mode and by the Filter, i.e. the smoothest Filter is **A**, and the sharpest Filter is **E**, but Filter **A** of the Standard (and Ultra Fast) Resolution is smoother than Filter **A** of the High Resolution, which is smoother than Filter **A** of the Ultra High Resolution mode. This also applies to other filters.

Matrix

The **Image Matrix** parameter is used to set the number of pixels that the reconstructed image will contain. Four options for matrices size are available: 340^2 , 512^2 , 768^2 and 1024^2 (768^2 and 1024^2 are optionally available).

Body images scanned in F. O. V. > 250 mm and Ultra-high resolution scans have to be reconstructed in the matrix size of 512^2 or greater, to retain full resolution and be free of most fan artifacts.

Head, spine and small body scans may be reconstructed in the 340² matrix with no loss of resolution. The smaller matrix has the advantages of faster reconstruction and smaller archive space for storing the reconstructed image.

When the F. O. V. is increased to more then 250 mm or the resolution increased to Ultra-High, the image matrix is automatically set to 512^2 if it was previously less than 512^2 .

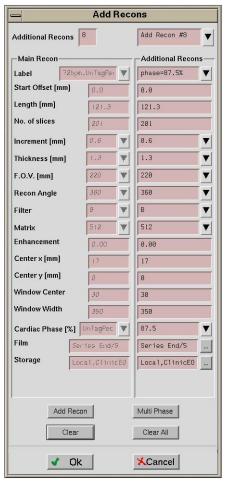
Higher matrices (768^2 and 1024^2) are needed for Ultra-High resolution images (e.g., ear) with F.O.V. > 125 and for High resolution body images with F.O.V. > 250 in order to display the full spatial resolution.

Recon Angle

The **Recon Angle** parameter is used to set the reconstruction algorithm $(360^{\circ} \text{ or } 180^{\circ})$. When the resolution in the scan protocol is **Ultra-High**, a selection of 180° causes the resolution to change to **High**.

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Add Reconstructions



Clicking the ____ button opens the **Multi-Reconstruction** dialog box. The example at left is a Reconstruction parameters dialog box for a Helix scan. For other modes, the parameters may be somewhat different.

It includes columns for **On-Line** and additional reconstructions.

In the left column, the scan and reconstruction parameters of the On-Line ("Main Recon") mode are displayed. The right column is the active column for changing the parameters for the additional reconstruction. Up to 10 additional reconstructions can be planned in advance.

Change parameters, if desired.

To delete one of the additional reconstructions, click **Clear** at the bottom of its column. To add a set of reconstructions where all the parameters are the same except a few, (e.g., where only the cardiac phase is different) click **Multi Phase**. (For a restrospective helix cardiac scan, you can set the number of phases and the specific phase to be reconstructed.)

After all parameters are set as desired, click **Ok**.

Cancel exits from the Multi-Recon box without

changing any value and returns to the Recon Parameters.

Reconstruction Function

There are two methods by which raw file data can be reconstructed offline:

1. From the **Scan** window Toolbox, click the **Recon** button or alternatively, from the **Study screen**, select **Off-Line Recon** on the **Processing** menu—a new viewer window opens, in addition to the **Archive Manager**.

Click the **IRS** button—the **Patients' Names** list appears. Select one or more **Raw Data Files** as required—click **OK**. On the **Recon Viewer** Title Bar, "**Offline Reconstruction**" appears with the patient's name next to it.

-- or --

2. Click the **Open File** icon on the Toolbar, or from the **File** menu select **Open**. Select one or more **Raw Data Files** for reconstruction.

Select **Off-Line Recon** on the **Processing** menu—a new viewer window opens and the patient's name appears next to "**Offline Reconstruction**" on the Title Bar.

- You can choose to perform raw data file **Offline** reconstruction for more than one patient at a time.
- The off-line reconstruction function can be operated only on raw data files that are stored in the IRS folder. However, it is possible to save raw files in EOD media for later reconstruction. In order to reconstruct a raw file from EOD, you must first copy the raw file to the IRS folder, then unload it to the Off-line Reconstruction application.

In either case, after selecting the raw data files for reconstruction, the **Protocol Parameters Window** (grayed out—for reference only) and the **Reconstruction Parameters** dialog box for the first file both open.

The **Protocol Parameters** dialog box is the same as the **Protocol Parameters Window** used during the **Plan stage** of the scan, except the **Short** tab doesn't appear.

Modify the reconstruction parameters, if necessary, and click **OK** for the reconstruction process to begin or **Cancel** to quit.

The images are reconstructed, displayed and stored. They can also be sent for filming.

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When the reconstruction of the first Raw has been finished, the message "Recon Completed" will appear in the lower right status window. A dialog box will appear asking if you wish to continue to the next Raw image or quit.

To skip a current Raw reconstruction, click **Cancel**—the next Raw parameter set appears. The displayed name of the patient changes accordingly in the Title Bar.

The example of the **Reconstruction parameters** dialog box on the previous page is for a Helix Scan. For other modes, the appropriate parameters are displayed.

When an off-line reconstruction of a loaded raw from the IRS disk is being applied, the default Reconstruction parameters that appear in the protocol are the same as those used for the final (full quality) reconstruction that took place during the scan.

Reconstruction Process

The first image of the set is reconstructed and displayed in the **Recon Viewer**. A **Confirmation Dialog Box** is displayed:

Reconstruction					
	Adjust Window and Zoom				
Continue reconstruction of series					
Ok Ok for all Edit Cancel Cancel all parameters					

Adjust Zoom and Window and click **Ok**. Reconstructions of the set are performed in the background. The first image which is reconstructed with its additional Recon #1 parameters and **Confirmation Dialog Box** are displayed. Repeat, as in the first image, as desired.

During the **Recon** process, the **Title Bar** will show the Patient Name.

Ok for all confirms the values for all additional reconstructions that will be performed without waiting after the first image.

To change reconstruction parameters, click Edit parameters. The Recon Parameters Dialog Box is opened again and parameters may be changed. After clicking on **Ok**, the slice is reconstructed again with the new parameters and the confirmation dialog box is displayed again.

If no button is clicked, after a preset time-out, the images are reconstructed.

Cancel stops the reconstruction of the rest of the images of the first reconstruction. The first image of the Add #1 is reconstructed and displayed.

Cancel all stops all reconstructions of the raw set, including the additional recons.

If several Raws with different parameters were selected in the **Archives**, a confirmation window is displayed.



If \mathbf{OK} is pressed, the next set's parameters dialog box is displayed, after confirming the last additional recon of the first selected Raw set (or, after clicking \mathbf{Ok} for all). Proceed as for the first set above. In the meantime, the previous reconstructions are performed in the background.

Repeat the above for all other Raw sets.

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Misc. Menu

Misc
Air Calibration
Tube Conditioning
Generate Protocol
Configuration
Impulse Response
Slice Width
Fix Patient Data
Voice Recorder
Auto Voice Control

The **Air Calibration** function is used for automatic calibration of the detection system in order to eliminate ring artifacts.

The **Tube Conditioning** (TC) function is used to purge gases from the X-ray tube. Tube conditioning is required if a long period has elapsed since the last X-ray operation.

The **Generate Protocol** function is used to change the preset scan protocols.

The **Configuration** function is used to configure the system according to the specific needs of the institution.

The **Impulse Response** and the **Slice Width** functions are used to check the resolution of the scanner during its monthly tests (refer to Appendix B for more details).

The **Fix Patient Data** function is used to correct details of patient data that is stored on disk.

The **Voice Recorder** function records messages which are used as part of the **Autovoice** option

The **Auto Voice Control** function is used for voice messages that are heard during the studies. Choosing the **None** will suppress all voice messages during the studies.

Service Menu

The **Service** menu consists mainly of functions used reserved for Philips Service personnel. A few of these functions may be of value to users. Refer to **Chapter 2, Vol. 1 – System Description** for details.

Calibrations

Air Calibration of the detection system is performed by the user in order to eliminate ring artifacts. (All other calibrations are to be performed by Philips personnel only.)

Schedule the Air Calibration procedure once a week, sometime during the day, when the scanner is at normal operating condition.

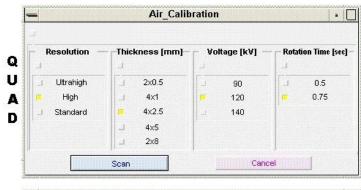


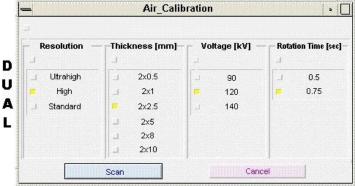
Warning!

Do not perform Calibration when there is a person present in the scanning room!

From the MISC menu on the Study screen, select the Air Calibration option. One of the windows shown at right will appear (depending on Quad or Dual model).

A yellow button in the dialog box indicates that the calibration mode will be performed;

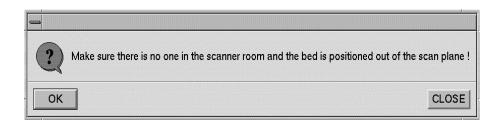




gray means that it will be skipped. The default is when all modes are yellow. To select or unselect all modes, press the **ALL** button.

After choosing the calibration modes to be performed, click the **Scan** button. The system prompts:

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If no one is present in the scanner room click CLOSE. A list of the calibrations to be performed will appear. Drag the lower border of the dialog box to view them.

At this point, calibration begins.

To halt the calibration process at any time, press on the Scan Control Panel or click in the Scan Toolbox.

The system performs warmup prior to calibration, if necessary.

Press Manual Scan on the Scan Control Panel to perform the first scan. Adjust window and check that there are no objects on the image. To perform

the rest of the scans automatically, press the **Auto Scan** icon.

The images of the performed calibrations will be displayed one after the other. Make a note of the scan modes with unacceptable images and repeat them at the end of the calibration process. Unacceptable images are those with streaks or very large amplitude rings.

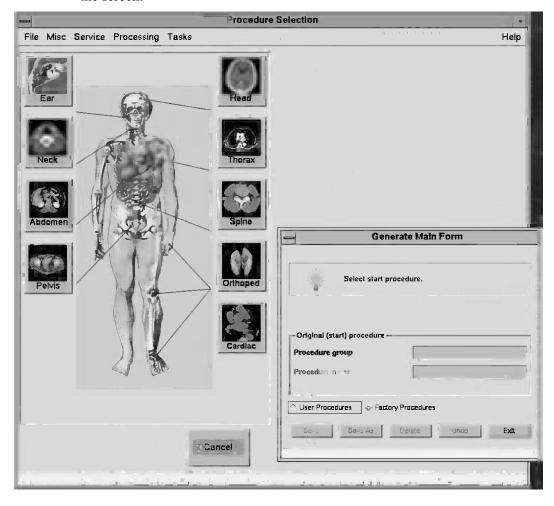
In special cases, if it is necessary to check the appearance of each image during calibration, press **Manual Scan** instead of **Auto Scan**. If the image is acceptable, continue to the next scan by pressing **Manual Scan** again.

At the end of the procedure, a dialog box appears with the message "Air Calibration finished successfully".

Warmup is automatically performed prior to Air Calibration.

Generate Protocol

This function is used for changing, deleting or duplicating Scan Protocols. From the **Misc.** menu on the Study screen or the Viewer, select **Generate Protocol**. The Generate Main Form dialog box appears at the bottom right of the screen.



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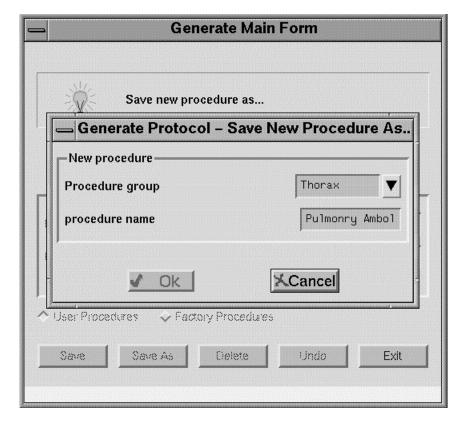
Select one of the mini-images, from which the generation of the protocol will begin. Selecting a mini-image automatically fills in names in the two fields of the dialog box. At the same time, the **Protocol Parameters** Window will open. After all parameters in that window are correct, click **OK**. Proceed by selecting one of the buttons at the bottom of the **Generate Protocol** Dialog Box. They are:

- Save
- Save As
- Delete
- Undo
- Cancel

If you wish to permanently replace the parameters in a protocol with the changes you have just made, select **Save**. However, if you wish to keep the original protocol, but generate a new Protocol with the changes you have just made, select **Save As.**

If you wish to delete the selected protocol from the set of protocols, select **Delete**. To re-edit the protocol parameters, select **Undo.** Finally, to exit the Generate Protocols application, select **Cancel**.

The factory procedures are the basic set of default protocols shipped with the system, and can be used as is, and can be viewed and copied, but not deleted. You can generate user procedures by editing copies of factory procedures, or by copying procedures from backups, or by editing existing user procedures.



When selecting **Save As**, the following dialog box will appear:

The top field in the box, **Protocol Type**, allows you to select the type (group) of protocol from the ComboBox. All of the available types of protocols will be displayed.

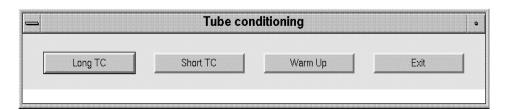
The bottom field is for typing the name that you choose as the generated Protocol name.

The new protocol will be saved in the "User" set of protocols. However, press on the Factory Default diamond to view the Factory Procedures if you wish to generate a protocol which is similar (or identical) to one of the original Factory Procedures.

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Tube Conditioning Program

From the **Misc.** menu, select **Tube Conditioning**. A dialog box opens to select the **TC** procedure. Follow the directions that appear on screen.





Warning!

Do not perform Tube Conditioning when there is a person present in the scanning room!

Long tube conditioning should be performed for new tubes, or when X-rays were not turned on for a week or more.

Warmup is performed automatically.

Short Tube Conditioning should be performed at the beginning of each workday.

Impulse Response

The **Impulse Response** function is performed monthly to check the resolution of the scanner. See Appendix B for the procedure.

Slice Width

This function is used to check the Slice Thickness (width) of the scanner during monthly tests. (Before activating the Slice Thickness function, be sure perform the preliminary procedures in steps 1, 2, and 3 below.)

- **1.** Perform Short Tube Conditioning.
- **2.** Perform Detailed Air Calibration at 120 kV, STD, for all **Slice Thicknesses**. This procedure also warms up the tube.
- **3.** Install the system phantom used for slice width measurements. Perform a lateral Surview scan and plan an axial slice in the middle of the four rectangles located on the phantom at 12, 3, 6 and 9 O'clock positions.

This is done to adjust the **Tilt** so that the phantom axis is perpendicular to the rotation plane. (The * entry for Tilt in the table below will cause the system to accept your last tilt setting.)

The CT number of the rectangles should be 110 ± 20 at 2x5 mm Slice **Thickness**. Adjust **In/Out** position of phantom to obtain better precision.

4. Perform the first Axial scan with the following parameters.

Parameters for First Slice Width Scan (2 x 5, Axial)				
Position	head first / supine		Recon.	On line
F.O.V. [mm]	250		Center X [mm]	0
Tilt	* [use * character]		Center Y [mm]	0
Length [mm]	10		Window Center	60
No. of Slices	2		Window Width	300
Increment [mm]	0		Filter	EB
Thickness	2 x 5		Matrix	512
Rot. Time [sec]	0.75			
Scan Angle	360			
Cycle Time	1			
Voltage [kV]	120			
mAs	300			
Resolution	standard			

- **5.** From the **Misc** menu, select **Slice Width**.
- **6.** Click the **Open Archive** icon and select the image for the measurement. Click **Ok**.

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- **7.** Click the **Vertical ROI** icon on the left tool bar. Move and rotate the ROI to symmetrically position it on the aluminum strip and parallel to the plastic rectangles.
- **8.** Click the **Plot** icon on the left tool bar, to view the sensitivity profile and results of the measurements.
- **9.** For each image, measure both vertical aluminum strips, then average the results and check that they are within the tolerance specified in Appendix B.
- **10.** Exit the **Slice Width** program and repeat the procedure from step 4 with slice thicknesses of 2.5, 1 and 0.5 mm; note that mAs, Resolution, and Filter also are different than the first Slice Width scan.

Parameters for 2 nd , 3 rd and 4 th Slice Width Scans (Axial)				
Position	head first / supine		Recon.	On line
F.O.V. [mm]	250		Center X [mm]	0
Tilt	*		Center Y [mm]	0
Length [mm]	*		Window Center	60
No. of Slices	2		Window Width	300
Increment [mm]	0		Filter	E
Thickness	2.5 / 1 / 0.5		Matrix	512
Rot. Time [sec]	0.75			
Scan Angle	360			
Cycle Time	1			
Voltage [kV]	120			
mAs	200			
Resolution	ultra high res.			

11. Check that the results are within the tolerances appearing in **Appendix B** (under Quad or Dual, depending on your system).

The smallest slice width value appears thicker than its marked (nominal) value. This is due to the measurement method used. To achieve a more precise measurement, a more sophisticated method should be used.

Voice Recorder

The **Voice Recorder** is used to add new messages, edit or delete messages that may be used during the scan process.

From the **Misc** menu on the Study screen or the Viewer, select **Voice Recorder**. The following dialog box appears on the screen:



The screen is divided into five sections:

- 1. General Instructions for all options on the screen
- 2. Options buttons
- **3.** Text box containing **Language** choices and **List** of existing sets of Pre- and Post- messages
- **4. Help** for the selected options
- 5. Operations buttons

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The following choices are available when using the **Options** buttons:

Create a new set

Creates a set (in all supported language) of pre-scan and post-scan messages. Each message can last up to 25 seconds.

• Delete entire set

Deletes a set in all supported languages of pre-scan and post-scan messages.

File names followed by the letter (L) are Locked, and cannot be deleted or edited.

Add Language

Enables the addition of new language(s) into the system. The name of the new language is added immediately to the list of languages. In order to record the messages in this new language, select the language by using the pull-down menu to the right of the language's ComboBox.

At this stage, the names of the sets of messages will appear in red, indicating that the message set is empty. After messages are recorded and saved, message entries will appear in green.

• Remove Language

Enables the deletion of all the messages in a specific language. When all messages are deleted, the language entry will automatically disappear from the list of Languages.

• Edit Set by Language

Enables the modification of an any existing set of messages. Only those messages which are not Locked may be edited.

• Clear Set in Language

Enables the deletion of sets of messages in a specific language. Only those messages which are not Locked may be deleted.

- The recorder microphone is located at the rear of the operator's console. In some cases the microphone may be located at rear of the electronic rack.
- Clicking on the **X** Cancel button will cause the application to exit. Any changes which have been saved, will be kept.
- After selecting a set of messages, it is possible to listen to the pre-scan and post-scan messages by pressing the PRE > or POST > button respectively.
- While listening, click the STOP button to stop the message.

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Archive Manager

Overview

The Archive Manager may be opened from any application such as the Study Viewer, MPR, Angiography and 3D, or at the bottom of the Status Display. The Archive Manager is used to:

- 1. Select and retrieve images from local and remote storage devices.
- **2.** Copy images and files from one device to another.
- **3.** Erase data from local devices.
- **4.** Format and rescue removable storage media.
- **5.** Quickly review images in the Quick Viewer.
- **6.** Display the remaining free space on storage devices.

The contents of the Archive Manager window can be displayed in three modes:

Patients & Series: the Patients list is displayed on the left, and the list of

the Series is displayed on the right.

Image List: the Patients list is displayed on the left, and the

information and attributes of the images of the selected Patient and Series are displayed on the right.

Mini Images: the Patients list is displayed on the left, and the

minified images belonging to the selected Patient and

Series are displayed on the right.

Archive Manager Window



The above window shows the Archive Manager window displayed in the Mini Images mode. The Archive Manager window consists of: a Title Bar, Menu Bar, Tool Bar, Archiving Devices Bar (icons) and a Main Area.

If the Archive Manager has been invoked by an application, then the **Title** of the window shows the name of the application from which the Archive Manager was activated (for example, **Viewer 1 - Archive Manager**). In addition the **Ok** and **Cancel** buttons appear at the bottom of the window.

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Menu Bar

The **Menu Bar** consists of several menu selections (shown in the shaded headings below). These menu selections, when clicked, display a drop-down list of functions that can be performed in Archive Manager.

File	Edit	View
Copy Images	Select Original	Patients & Series
Copy Series	Select Derived	Image List
Delete		Mini Images
Save As		By Patient Details
Lock Patients		Recent Days
Unlock Patients		
Refresh		
EOD Maintenance		
Gyrex Connection		
MasterFilm		
Logout		
Exit		

Functions available from the 3 menus are summarized below and described in detail later in this chapter.

File includes the following file management operations:

- Copy Images copies images from one device to another.
- **Copy Series** copies whole series from one device to another (active in the Patients & Series mode only).
- **Delete** erases images from the local archiving devices.
- Lock Patients insures that selected patients cannot be deleted.
- **Unlock Patients** enables previously locked patients to be deleted from the Archive Manager.
- **Refresh** updates the display of the archive to reflect images that have been added or deleted.
- **EOD Maintenance** formats, ejects and rescues Erasable Optical cartridges (rescuing does not work in all cases).
- **MasterFilm** inspects, manipulates, rearranges and prints the images that were filmed in any application.
- **Queue Manager** inspects, changes priority, or removes copy transactions of image/series from one archiving device to another.

- Logout logs out of the system.
- Close exits the Archive Manager.

Edit menu selections enable differentiation between original (acquired) and derived (post processed) images.

View menu selections allow changing the viewing mode:

- Patients & Series for listing the patient names and series; used for selecting several patients and series together for copying, deleting, and loading to applications.
- Image List for listing patients and the image information.
- **Mini Images** for displaying the patients names and the minified images of the selected patient (not available on some remote stations).
- **By Patient Details** lists only those patients that match user-selected details.
- Recent Days lists only patients with the most recent studies.

Processing and **Tasks** menus are described in **Chapter 2**, **Vol. 1 – System Description**.

The Processing menu is not available if the Archive Manager was activated by **File/Open** from within an application; in that case, click on **Ok** or **Cancel** at the bottom of the window to return to the activating application.

Tool Bar

The **Tool Bar** includes the icons that represent the most frequently used operations of the Archive Manager:



The icons (from left to right) are:

- View Patients & Series
- View Image List
- View Mini Images

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- **Cancel** an operation that takes too long (the pointer is in the shape of a watch for too much time).
- **Refresh** screen with newly arrived images.
- A mark _____ appears on the Tool Bar when **Display by Patient Details** or **Recent Studies** is active. This is to remind the user that only part of the patients are listed. To view the full list, cancel Display by Patient Details or Recent Studies, whichever is active, or click on the _____ icon.

Archiving Devices

The available **Archiving Devices** appear as icons on a bar below the Tool Bar. The patients from the devices whose icons are in bright green special (active) are displayed in the patient list.

Main Area

The **Main Area** of the window displays the list of patients and series, or patients and slices or mini-images, depending on the viewing mode.

Ok and Cancel buttons

The **Ok** and **Cancel** buttons appear at the bottom of the screen when the Archive Manager is invoked from an application. Click on **Ok** to return to the application with the selected images as input, or on **Cancel** to return without changing the images in the application.

If **Ok** and **Cancel** buttons are not displayed, select the application from the Processing menu.

Pop-Up Menu (right mouse button)

To change between the Archives Manager display modes, a pop-up menu can be used in addition to the tool bar. Click on the right mouse button while the pointer is over the list of patients or slices. From the pop-up menu select the desired mode. The pop-up menu performs the same functions as the appropriate icons on the tool bar or the menu bar, but without moving the pointer from the list area.

Selecting Images

To change the storage device:

- 1. Click on the **active** device icons on the Toolbar (marked by a bright green color) to make them inactive.
- **2.** Click on the desired device to display its list of patients. To select additional devices, click on their icons.

The names of the patients stored on the selected devices are then listed.

Several devices can be active at the same time.

Selecting Images in the Image List and Mini-Images modes. The techniques for selecting images depend on the viewing mode. Use the Patients & Series, Image List and Mini-Image icons to switch to the corresponding viewing mode.

- 1. Click on the patient's name.
- 2. The list of series is displayed below the patient's name. If there is only one series, the images of that patient are listed or displayed as minimages.
- **3.** If there is more than one series, click on the desired series; the series number is highlighted and its image list or mini-image list is displayed.
- **4.** Alternatively, click again on the patient's name to select all the series under this patient. Now all the series numbers are highlighted, and the image lists, or mini-images, of all the series are displayed. Another click on the patient name will unselect all of the series.
- **5.** All images are marked as selected. If mini-images are displayed, the selected images are marked by yellow frames. In the Image List mode, the corresponding rows are highlighted.

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- **6.** To **add another series** or **patient**, hold down the **Ctrl>** key and click on the desired series or patient. Holding down the **Ctrl>** key and clicking a selected series or patient, unselects it.
- 7. To select a single image from the list of images, click on the minimage or the image row. The image is selected and any previous selection is canceled.
- **8.** To **select all the images** in the series, click on the **ALL** button below the list.
- **9.** To **deselect all images**, click on the **NONE** button below the list.

To select a range or ranges of images:

- **1.** Click on the first image to be selected.
- 2. Press and hold the **Shift**> key and click on the last image in the range. All the images in between are selected. Alternatively, drag the mouse from the first image to the last.
- **3.** To cancel the range, select any other item.
- **4.** To add items that are not in the range, press and hold the **<Ctrl>** key and click on the desired images or drag the mouse over the desired range of images.
- **5.** To deselect an already selected image or range of images, click on the image or drag the mouse over the range of images with the **Ctrl>** key pressed.

To select several series of one patient:

- 1. Click on the **Patients & Series** icon on the toolbar.
- **2.** From the Patients list, click on the patient to be viewed. All the series belonging to the patient appear to the right of the Patients list and are highlighted (selected). At the same time, the total number of images in the study is also displayed.
- **3.** Select a range of series or a random series using the **Shift**> or **Ctrl>** key. The selected series are highlighted.

To select every 2nd, 3rd or nth image:

- 1. Select the desired patient case (or part of its slices) and click on the SELECT-SUB button located on the bottom-right corner of the Archive Manager screen. Select from the displayed list every second, third image, etc.
- **2.** The Select-Sub function can be applied iteratively on the last selected images.

After selecting one of the options, the same option cannot be reused. For example, after selecting every second image, this option cannot be used again. However, every third image can be selected with a final result of every sixth image being selected.

To select several patients with all their images:

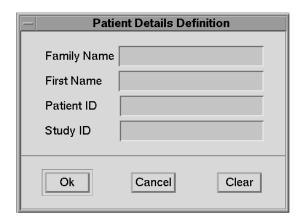
- 1. Click on the **Patients & Series** icon on the toolbar.
- 2. Click on the first patient name on the Patients' list.
- **3.** Press and hold the **Shift**> key and click on the last patient in the range. All the patient names in between are highlighted. The image list is not displayed.
- **4.** To add non-consecutive patient names to the selection, press and hold the **<Ctrl>** key and click on the desired patients. To add a range, drag the mouse over the desired patients. The selected patients are highlighted and their series are displayed to the right of the list.
- **5.** To deselect a selected patient or series, click on it with the **Ctrl>** key pressed. To deselect a range of patients or series, drag the mouse over the range with the **Ctrl>** key pressed.
- **6.** To cancel the previous selection, select any item.

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Displaying a List of Selected Patients

To list only patients whose names or IDs begin with certain letters:

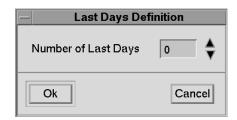
1. From the View menu, choose **By patient details**. The following Dialog Box is displayed:



- **2.** Fill in the required data. The beginning of the name may be used to display all patients whose name begins with the typed letter(s). Only the patients that match the entered data will be displayed.
- 3. To redisplay all patients, click on Clear and then on Ok, or click on icon on tool bar.

To list only patients with the most recent studies:

1. From the View menu, choose **Recent Studies**. The following Dialog Box is displayed:



- **2.** Type the desired number of days.
- **3.** To redisplay all patients, enter the value of 0 (zero) into the Last Days field, or click on icon on tool bar.

- When accessing a remote device, listing of all the patients may take a considerable length of time.
 Using the By patient details mode, or Recent days mode can shorten the response time.
- 3. If a device appears empty, make sure that the Patient Details and Recent Studies are cleared so that all patients will be displayed.

To find a specific Patient/Series/Image in the Patients/Series/Images list, type some part of the displayed Patient/Series/Image recorded in the Find field below the list. A location cursor (dashed frame) is placed over the first item whose record contains the specified text. Pressing <Enter> selects this Patient/Series/Image. Clicking on Find moves the cursor to the next match.

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Displaying an Image in the Quick Viewer

To **display an image quickly** from the Archive Manager without activating the Viewer, double-click on its mini-image or its row in the images list. A window opens with the image displayed in it. The image may be windowed, zoomed, panned, filmed and its parameters displayed. For details of the operations, refer to **Chapter 5**, **Vol. 1 - Viewer**.

To display another image, double-click on its mini-image or row.

To display several images with the windowing and zoom of the first one, proceed as follows:

- Adjust the window and zoom of the first image for optimal viewing.
- Click on for keeping the same window CENTER and WIDTH for the next images.
- Click on for keeping the same zoom and pan for the subsequently displayed images.

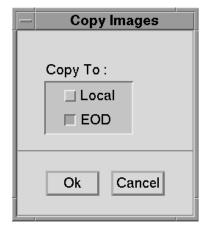
To exit, click on

All other **Quick Viewer** operations can be found in **Chapter 5**, **Vol. 1** - **Viewer**.

Copying Files between Devices and Stations

To **copy patient files** from one device to another:

- 1. Select the patients, series, and slices as required.
- Click on File on the Menu Bar and select Copy Series (in the Patients & Series mode), or Copy Images (in the Image List and Mini-Images mode). A Dialog Box (like the one below) is displayed:



Note: The list of devices depends on the installed devices and connected remote stations.

<u>Hint</u>: To copy an entire series, it is more efficient to use **Copy Series** and not **Copy Images**.

- **3.** Select the devices to which the selection is to be copied by clicking on them. Clicking on an already selected device deselects it. Several devices may be selected for simultaneous transfer.
- **4.** Click **Ok** to initiate copy.

To monitor the progress of the Copy process, use the **Queue Manager** from the File menu. See the corresponding section for details.

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Deleting Files

Deletion of files is possible only on local devices, not on remote stations.

To erase slices from a device:

- 1. Select the storage device.
- 2. Select the patients, series, and slices to be deleted.
- **3.** From the **File** menu, select **Delete.**A Warning Dialog Box asks to confirm the deletion of the slices. Click **Yes** to delete, or **No** to exit without deleting the images.

Locking and Unlocking Files

Locking the patient files protects them against erasing. When erasing a locked patient is attempted, a message is displayed informing the user that the patient files are locked and should be immediately unlocked if erasure from archives is really desired.

Locking and Unlocking Files is available in the Patients and Series viewing mode.

To Lock/Unlock files:

- 1. Set the viewing mode to **Patients & Series**. In the first column, at the right of the patient name a letter denotes the status of the patient files: U for Unlocked, L for Locked.
- **2.** Select one or more patients by clicking or dragging. The selected patients appear highlighted.
- **3.** From the **File** menu, select the desired option (**Lock/Unlock**). The patient's status is changed.

✓ Note:

If the study is locked, the **Auto Delete** function will not delete it or affect any of its components

Sorting Patient Files in Patients & Series Mode

In the Patients & Series mode, the file list may be sorted according to the following parameters:

- Device
- Patient Name
- Patient ID
- Study ID
- Study Time
- Accession Number
- Referring Physician
- Protocol Name
- Body Part
- Series description

The title of the Patients' list consists of pushbuttons which, when pressed, sort the list according to the marked parameter. To sort:

- 1. Click on the desired button in the title of the Patients' list. The button appears pressed and becomes white. To sort in the **inverse** order, click a second time on the same title.
- **2.** To sort the patients by a secondary criterion (within the primary, the white button), click on a second button with the **Shift>** key pressed; the secondary criterion is wheat-colored.

To sort in the **inverse** order, click a second time on the same title, with the **Shift>** key pressed.

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Sorting Image Files in Image List Mode

In the Image List mode, the file list may be sorted according to the following parameters:

- Type
- Contrast
- Image Number
- Location (Table Position)
- Acquisition Time
- Body Part
- Protocol Name

To sort:

- 1. Click on the desired button in the title of the image list. The button appears pressed and becomes white. To sort in the **inverse** order, click a second time on the same title.
- 2. To sort the images by a secondary criterion (within the primary, the white button), click on a second button with the **Shift**> key pressed; the secondary criterion is wheat-colored. To sort in the **inverse** order, click a second time on the same title, with the **Shift**> key pressed.

4

Free Space

To find out how much free space is available on a storage device:

- 1. Click on the device icon with the right mouse button.
- **2.** Select the **Free Space** option from the pop-up menu. A Free Space Summary Report for the device is displayed.

The Archive Manager also displays the amount of free space for the currently open devices in the lower right corner.

Verifying Connection

To verify the status of the connection to a storage device:

- 1. Click on the device icon with the right mouse button.
- **2.** Select the **Verify Connection** option from the pop-up menu. A Connection Status Report is displayed.

Disk Maintenance

Disk Maintenance operations include rebuilding, formatting and ejecting cartridge, as well as rescuing data from the local disk or from a damaged optical cartridge. To access the Disk Maintenance operations:

- 1. Click on the device icon with the right mouse button. A pop-up menu appears.
- **2.** Select the desired operation from the menu.

If there is **only one device**, you can also:

- 1. Select **File** from the Menu Bar.
- **2.** Select the **EOD Maintenance** option from the File menu.
- **3.** Select the desired operation from the EOD Maintenance menu.

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The following options appear in the Disk Maintenance Menu:

Rebuild

This operation tries to recover the data on any local device (hard disk or EOD) by attempting to reconstruct the Dicom file system. If this function is used for an EOD then the **Rescue** operation is automatically invoked prior to rebuilding the Dicom file system.

- 1. Click the device icon with the right mouse button. A pop-up menu appears.
- **2.** Select the **Rebuild** operation from the menu.

If there is **only one EOD device**, you can also:

- 1. Select File from the Menu Bar.
- 2. Select the EOD Maintenance option from the File menu.
- **3.** Select the **Rebuild** operation from the EOD Maintenance menu.

Try to perform the **Quick** rebuild. If the operation doesn't succeed, perform the **Full** rebuild.



Caution

After Rebuilding, the locked files become unlocked and may be inadvertently erased. From the File menu, use Lock Patients function to lock the files again

Format

This operation formats the EOD cartridge before first use.

Rescue Data

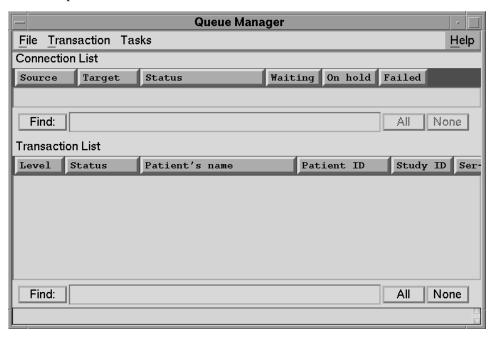
This operation tries to recover the data on a local EOD device by attempting to correct the Unix file system. This corruption may occur due to untimely ejection of the cartridge or as a result of a power failure.

Eject This operation is used to eject the cartridge from the device.

Note: If the EOD is busy, a dialog box opens indicating the EOD is in use.
Click Ok to eject the cartridge or Cancel to quit without ejecting.

Queue Manager

The Queue Manager is used to monitor the progress of the Copy process and to change it. From the File menu, select **Queue Manager** and the following window opens.



The Queue Manager window contains two lists: a **Connection List** and a **Transaction List**. A "connection" is uniquely identified by a *source device/target device* pair. When an item from the Connection List is selected, the transactions associated with the selected connection are displayed in the Transaction List. Each line listed in the Transaction List corresponds to an image or a series that is to be copied from the source device to the target device.

You may select one or more items from the Transaction List using the mouse, and then specify an operation from the Transaction menu to be applied on the selection.

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To **select all the transactions** in the list, click on the **ALL** button below the list. Use the **NONE** button to unselect all transactions.

To **find a specific transaction**, type some part of the transaction record in the **Find** field. The mechanism is similar to that of the Patient/Series and Image lists.

The following operations are available from the File menu.

Refresh Updates the display of the Queue to reflect any changes occurring after the Queue has been displayed.

Auto Refresh Automatically updates the Queue display periodically.

Queue Manager Invokes another Queue Manager.

Exit Exits the Queue Manager.

The following operations are available from the **Transaction** menu:

Retry Perform another attempt to transmit transactions whose transfer has failed.

Raise priority Moves selected transactions to the top of the Queue so that they are copied first.

Lower priority Moves selected transactions to the bottom of the Queue so that they are copied last.

Hold Temporarily suspends the copying process of the selected transactions. To **resume** copying, use **Retry.**

Remove Deletes selected transactions from the Queue so that they **Transaction** are not copied.

Logout

To **exit** from the present user's account while closing all applications, select **Logout** from the File menu.

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Viewer

This chapter describes the following Viewer functions:

- File
- Edit
- View
- Operations
- Options
- Windowing

The operations available within these general function categories are also common to many of applications of the Mx8000 Series scanning systems. Additional information about these functions is also given in **Chapter 2**, **Vol. 1** – **System Description**. The Graphics function is covered in **Chapter 6**, **Vol. 1** - **Graphics**.

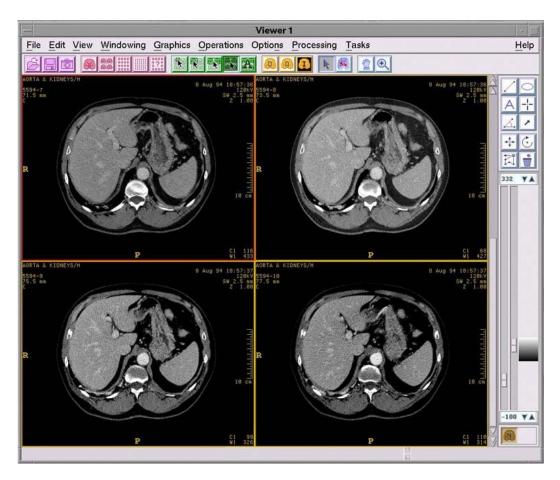
Overview

The **Viewer** is used for viewing and manipulating images. It can display a single large image or it can be divided into a number of frames for the display of several images simultaneously. The images to be viewed can be selected from any local or remote archiving device.

More than one Viewer window or application can be brought to the screen. The size of each Viewer window can be expanded to cover the entire screen or reduced to allow simultaneous display of several independent viewer windows or applications.

Each image or group of images can be individually manipulated with functions such as zooming and *windowing*. In addition, you can scroll through the images and film them. Simultaneous viewing of the same image with different zoom and *window* parameters can be achieved by duplicating images and placing them side-by-side or one above the other.

Viewer Window



Title Bar

The **Title Bar** contains the name of the application (Viewer) and an ordinal number to differentiate between several open Viewers. It is also used for moving the window by dragging it with the left mouse button pressed.

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Menu Bar

The **Menu Bar** consists of several menu selections (shown in the shaded headings below). These menu selections, when clicked, display a drop-down list of functions that can be performed in the Viewer application.

File	Edit	View	Operations	Windowing
Open	Reset All	One Image	Select	(details later in this
Add Images	Сору	Four Images	Pan	chapter)
Add Groups	Cut	Sixteen Images	Zoom	
Refresh	Add to Clipboard	Max No. of Images	Enhance	Graphics
Save Image(s)	Paste	Number of Images	Flip	(see Ch6, Vol1)
Save As	Swap	Sort Images	Rotate	
Save As Multiformat	Duplicate	Multiformat	CR/RF/NM Full Resolution	
Film Image(s)	Delete Images	Dual		Processing
Film As Multiformat	Select All	Groups	Options (see Ch2, Vol1)	(see Ch2, Vol1)
MasterFilm	Select None	Fit Window	Enhancement Square Size	
Queue Manager	Select	Add Blank Images	Display Utilities	
Logout	Copy Windowing	Image Parameters		Tasks
Exit	Copy Zoom	Add Parameters Frame		(see Ch2, Vol1)
	Copy Enhancement	Cine		
	External Clipboard			
	Overlays Color			
	Overlays ON/OFF			

Refer to the balance of this chapter for details on how to use the operations available in the **Edit**, **View**, **Operations**, and **Windowing** menus.

Refer also to Chapters 2 and 6 (volume 1), for descriptions of other menu selections that are common to this and many other applications of the Mx8000 scanner.

Following are selections that may not be common to other applications:

- The External Clipboard allows copying and moving images to other applications (including another Viewer window).
- The CR/RF/NM resolution option displays the image data in the original matrix.

Tool Bar

The **Tool Bar**, shown below, contains the icons for activating frequently used Viewer functions. All Tool Bar functions are also available from the Menu Bar. Refer to **Chapter 2, Vol. 1 – System Description** for descriptions of all the selections of the bar shown below.



Message Line

The **Message Line**, located at the bottom of the screen, displays on-line help and system messages.

Scroll Bars

The leftmost **Scroll Bar**, on the right side of the window, is for scrolling through the images. When there is only one row of images, the **Scroll Bar** is located at the bottom of the window.

Tool Box

The **Tool Box** located on the right side of the Viewer window contains the graphical aids for annotating and measuring features on the images

For detailed operation instructions of the graphic elements, refer to **Chapter 6**, **Vol. 1 - Graphics**.

Pop-up menu (right mouse button)

A **pop-up menu** can be invoked. It appears on the image and can be used to activate the most commonly used functions and tools. To invoke the pop-up menu, place the pointer on any one of the images and click the **right** mouse button.

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Retrieval of Images from Archive

To retrieve images from archives, click on the button on the Tool Bar or select **Open** from the File menu. Select the study to be viewed from the Archive Manager (refer to **Chapter 4**, **Vol. 1 - Archive Manager**) for more details).

After confirming the selection of images from the archives, the images are retrieved to memory and the images begin to appear on the Viewer window; the previous images in the Viewer are deleted from the Viewer (not from the archive).

To add images from the archive without deleting the previous images, select **Add Images** from the File menu.

Saving Images

To save the selected images to archives, click on the **Save** button on the Tool Bar or select **Save** from the **File** menu. In the dialog box, type a label, if desired, and select the archives in which you wish to save the images. Each image is saved as a separate file.

Images can also be saved in the following modes:

Multiformat: From the **File** menu, select **Save as Multiformat**. A window opens up for selecting the archives in which you wish to save the images, as well as the number of images in each frame. Each frame, containing the selected number of images, is saved as one file.

Gif, Tif and Pcx: From the **File** menu, select the **Save as...** option. A dialog box appears. Click on the desired graphic format type and enter a name for the resulting image file. The files are saved in a temporary Unix directory, /usr/tmp, from which they can be copied to floppy (optional) or transferred by FTP to any connected PC, Mac or workstation.

Image Selection Modes



Before performing any function, select the image or group of images for manipulation according to one of the following selection modes:

1. Select Sub-frames is used to select individual images in a Multiformat frame.

To select an image, click on it. To select more than one image in the frame, hold down the **<Shift>** or **<Ctrl>** key and click on the desired images.

2. Select Frames is used to select whole frames. Each frame may contain one image, or, in Multiformat mode, several images. If the clicked frame contains several images in Multiformat, the whole frame with all the images is selected in this mode.

To select a frame, click on it. To select more than one frame, click on the desired frames while keeping the **Shift>** or **Ctrl>** key pressed.

- **3. Select Groups** is used to select all the images of the same kind in the window, for example one of the pairs of DUAL images or a group. Clicking on any image selects all the images of that group. When images from more than one series are in the Viewer, clicking on any image selects all images from the same series.
- **4. Select Whole window** is used to select all the images displayed in the window. Images that are scrolled into the window are automatically selected and images that are scrolled out are deselected.
- **5. Select All** selects all the images in the Viewer, including those that are not displayed in the window.

The above selection modes can be activated by clicking the icon located on the Tool Bar or, alternatively, by selecting them from the **Edit** Menu.

Notes

- 1. The selected images are enclosed within a **yellow** frame.
- The active image is enclosed within a red frame. Operations are performed in real-time on the active image, while the rest of the selection is updated during pauses.

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Setting Number of Images in the Viewer Window

To set the number of images that appear in the Viewer window, click on one of the following icons on the **Tool Bar** or select from the **View** menu:



One-image to display a single large image.



Four-images to display 4 images in a 2x2 format.



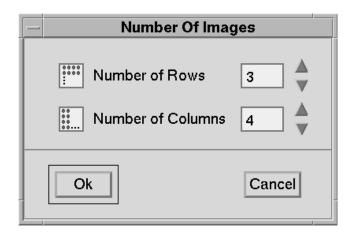
Sixteen Images to display 16 images in a 4x4 format.



Max. No. of Images to display all the images of the case.



Number of Images (?) to display a user-set number of images. The following Dialog Box is displayed:

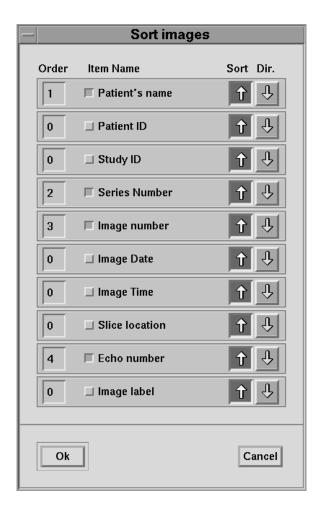


Enter the number of rows and columns or click on the up/down arrows to set the number of images in each dimension. Click **OK**. The images will now appear in the defined format.

5

Sorting Images

The images are initially displayed in the order in which they were listed in the Archive Manager. In some cases it may be necessary to view the images in a different sorting order. To do this, from the **View** menu select **Sort Images**. The following dialog box opens:



The Sort Images dialog box contains a list of Item Names that may be used as the sort index. Use the **Order** field to set the sorting priority of the Item Names and the **Sort Dir**. arrow buttons to set the ascending or descending order direction of each item.

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For example, if you would like to sort the images by **Patient Name** as the main index in ascending order and then by **Image Date** as the secondary index in descending order, proceed as follows:

- Type 1 in the Order field on the Patient Name line
- Click on the 1 button, if not already pressed,
- Type 2 in the Order field on the Image Date line
- Click on the button
- Clear all other items by clicking on the item names whose check boxes are shaded
- Click on the **OK** button

The images will be sorted accordingly

When the Item Name is switched OFF, the Order value is automatically set to **0**. If you change the Order field from **0** to any other value, then the Item Name is automatically switched ON (its check box becomes shaded).

5

Rearranging Images in the Viewer

Images can be moved from one frame to another by using the **Cut and Paste** functions.

To **move** a selection to another place in the Viewer:

- 1. Select the image or group of images to be moved.
- 2. Press <Ctrl> + <X> on the keyboard to cut the selection out from the present place. Alternatively, from the Edit menu, choose Cut. The selection is now deleted from the window and is stored on the clipboard (temporary storage memory).
- 3. Click on the frame where you want to insert the selection.

 Press <Ctrl> + <V> to insert the selection or from the Edit menu, choose Paste. The selection is inserted from that frame onward. The rest of the images, including the image that formerly occupied the frame, will be pushed down or moved to the right.

To **swap** between two images:

- 1. Click on one of the images to be swapped.
- 2. Press <Ctrl> + <W> or alternatively, from the Edit menu select Swap.
- 3. The pointer changes to **3**.
- **4.** Click on the second image to be swapped. The two images are now exchanged.

To copy a selection to another place in the Viewer:

1. Select the image or group of frames to be copied.

Press < Ctrl> + < C>, or, from the Edit menu select Copy.

The selection is copied onto the clipboard and is not deleted from the screen.

- **2.** Click on the frame where you want to insert the selection.
- 3. Press <Ctrl> + <V>, or, from the Edit menu select Paste.

 The selection is inserted from that frame onward. The rest of the images, including the image that formerly occupied the frame, will be pushed down or moved to the right.

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When storing images on the clipboard using the Copy or Cut operations, the previous contents of the clipboard are erased. To add the selection to the clipboard without deleting the previous images on it, use **Add to clipboard** function in the **Edit** menu instead of **Copy** or **Cut**.

To **delete images** from the Viewer (not from the archives), select the image or group of images to be deleted and press **Ctrl><D>**, or, from the **Edit** menu, choose **Delete Image(s)**. The remaining images will fill the freed space.

To copy images to another Viewer or to a specific place in the MasterFilm:

- 1. Select the image or group of frames to be copied.
- 2. In the Edit menu, select External Clipboard and from the sub-menu select Copy, Cut or Add.
- 3. Bring the target Viewer or the MasterFilm to the foreground by clicking on it or selecting it from the Tasks menu (the MasterFilm may also be activated from the File menu). Click on the frame to which you wish to copy the images.
- 4. In the Edit menu of the target Viewer or MasterFilm, select External Clipboard and from the sub-menu select Paste. The selection is inserted from that frame onward. The rest of the images, including the image that formerly occupied the frame, will be pushed down or moved to the right.

Add Parameters Frame

The image parameters can be displayed as an image in the display area:

- 1. Click on the image whose parameters are to be inserted.
- **2.** From the **View** menu, select **Add image frame**. All the images following the selected image will be shifted by one space and the Image Parameters will be displayed in the image window to the right of the selected image.
- **3.** To remove the Image Parameters Frame, use the **Delete Image** option in the **Edit** menu.
- **☞ Note** The image parameters frame can be filmed.

Add Blank Image

To insert a blank image to the display area:

- 1. Click on the frame where you would like the blank image to be inserted.
- 2. From the Edit menu, select Add Blank Image. All the images from the selected image and onwards will be shifted by one space and the Blank Image window will be inserted at the position of the selected image.
- **3.** To remove the Blank Frame, use the **Delete Image** option in the **Edit** menu.

Text and graphics may be added in the blank frame and can be filmed; however, saving to archives is not possible.

Scrolling Through the Images

The leftmost **Scroll Bar**, on the right hand side of the window, is used for bringing other images of the series to the Viewer window. The order of the images is left-to-right and top-to-bottom.

To scroll through the images **one-by-one**, click on the **up** or **down** single arrow button, located at the top or bottom of the scroll bar.

To scroll through the images **line-by-line**, click on the **up** or **down** double arrows.

To scroll through the images **page-by-page**, click on the **scrollbar** below or above the slider. Alternatively use the **PageDown>** and **PageUp>** keys on the keyboard. All the images in the window are replaced by the next or previous images.

To display the beginning of the series press the **Home**> key on the keyboard; to reach the end of the series, use the **End**> key.

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Zoom and Pan

Zoom is used to magnify or reduce the size of the image.

Pan is used to move the image for centering the feature of interest in the image frame.

Zoom and Pan may be activated by clicking on the **Zoom** or **Pan** pushbuttons on the Tool Bar or by selecting them from the Operations Menu. The **Select** function in the Operations menu is used to deselect graphics, zoom and pan buttons, thus enabling the selection of images on the display.

To display the feature of interest with the optimal size and centered in the image frame:

- 1. Select the image or group of images to be zoomed and panned.
- 2. Click the Zoom pushbutton located on the Tool Bar or from the Operations menu choose **Zoom**.
- 3. The pointer changes to **(O)**. A text box appears to the right of the Zoom icon.
- **4.** To magnify the image, drag the mouse up (a factor up to 10 is available).
- **5.** To reduce the image, drag the mouse down (a factor down to 0.8 is available).
- **6.** For a precise zoom factor, type the desired value in the text box to the right of the Zoom icon. For small changes, click on the up or down arrows to the right of the text box.

If images with different zoom factors are selected, the zoom value in the text box is colored blue and represents the zoom of the active (red frame) frame and not of the whole selection.

7. To reposition the image within its frame, click on the Pan icon on the Tool Bar or select Pan from the Operations menu. The pointer changes to . Drag the image in the desired direction.

To **copy the zoom and pan values** of the active frame to another image or group of images:

- 1. Select the image or group of images to be changed.
- **2.** Click, while keeping the **Shift** key pressed, on the image which is used as a model for zoom values.
- **3.** From the **Edit** Menu, select **Copy zoom**. The zoom and pan values are copied from the active image to the selection.

To revert to the original size, position and windowing level of the images before zooming and panning, select Reset All in the Edit menu.

Enhance

Enhance is used to sharpen or smooth images. It is activated by clicking the **Enhance** pushbutton on the Tool Bar or, from the **Operations** menu, by selecting the **Enhance** option. A text box with the exact enhancement factor is opened to the right of the Enhance button on the Tool Bar.

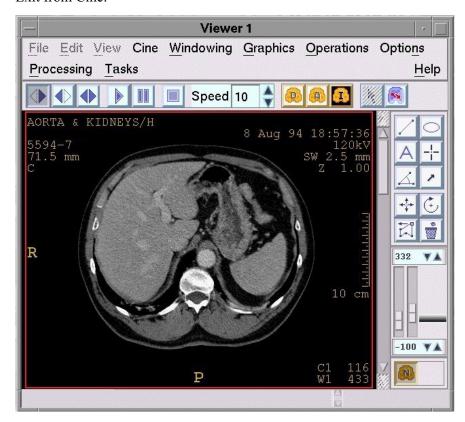
To enhance an image:

- **1.** Select the image or group of images to be enhanced.
- 2. Click the Enhance pushbutton located on the Tool Bar or from the Operations menu choose **Enhance**.
- 3. The pointer changes to **. A text box appears to the right of the **Enhance** icon.
- **4.** To sharpen the image, drag the mouse up (a factor up to 5.0 is available).
- **5.** To smooth the image, drag the mouse down (a factor down to -1.10 is available).
- **6.** To achieve a precise enhancement factor, type the desired value in the text box to the right of the Enhance icon. For small changes, click on the up or down arrows to the right of the text box.

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Cine

To display the images continuously in a rapid, cyclic sequence on the screen, from the View menu choose **Cine**. When **Cine** is chosen a menu bar entry **Cine** is enabled with the options Forward, Backward, Forward & Backward, Exit from Cine.



The Tool Bar also changes and displays a new set of buttons which correspond to the buttons in the Cine Menu option.

To **display images in the forward direction**, from the first image to the last repeatedly, click on the icon.

To display images in the backward direction, from the last image to the first, repeatedly click on the icon.

To display the images back and forth, click on the icon.

To **change the display rate**, type the desired number of images/second in the Speed textbox or increase/decrease the number by clicking on the arrows at the right of the speed number.

To start the cine display, click on the Run button.

To interrupt the cine display, click on the Pause libutton.

For manual leafing through the images, use the scroll bar on the right side of the image.

The Enhance button on the Tool Bar is inactive.

To exit and return to the Viewer click on the **Exit** button.

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Rotate Image by 90 degrees

Images can be rotated by 90 degrees clockwise or counterclockwise.

- **1.** Select the images to be rotated.
- 2. To rotate images by 90 degrees, from the Operations menu, select Rotate. A sub-menu appears. Select Clockwise or Counterclockwise. All selected images will be rotated by 90 degrees clockwise or counterclockwise, while the orientation notations are changed accordingly.

- Surview and Locate images with lines denoting planned or executed slices cannot be rotated; when selecting images for rotation make sure to exclude Surview/Locate images with lines.
- Rotated images cannot be filmed or saved. When they are sent to MasterFilm or Archives, they revert to the original upright position.

Flip Image

Images can be flipped from left to right or up and down.

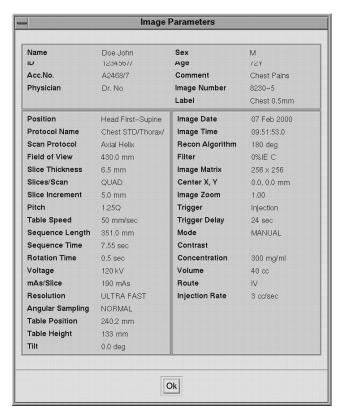
- **1.** Select the images to be flipped.
- **2.** To flip images **left-to-right**, from the **Operations** menu, select **Flip**. A sub-menu appears. Select **Horizontal**. The image will appear as a mirror reflection flipped left-to-right, while the orientation notations are changed accordingly.
- **3.** To flip an image **upside/down**, from the **Operations** menu, select **Flip**. A sub-menu appears. Select **Vertical**. The bottom of the image is brought to the top while the orientation notations are changed accordingly.

Image Parameters

Display

Patient information, scan technique factors and reconstruction parameters can be displayed on the screen.

- 1. Click on the image whose parameters are to be displayed.
- **2.** From the **View** menu, select Image Parameters. The parameters of the image are displayed in a separate window.



3. To remove the parameters window, click **OK**.

For detailed explanation of the image parameters, refer to **Chapter 3**, **Vol. 1** – **Scanner Operation**.

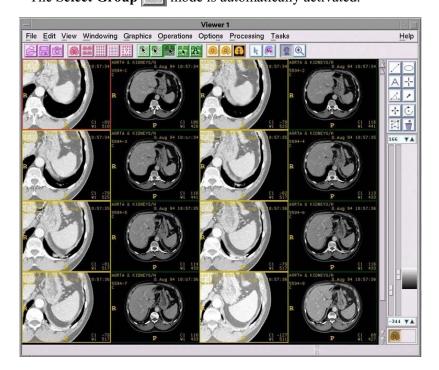
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Dual Images

Dual Images replicates each image in the Viewer and displays it to the right or below the original.

To view **Dual Images**:

1. From the View Menu, select **Dual**. A sub-menu appears. Select **Horizontal** or **Vertical** mode. The images are duplicated to the right of the original image (Horizontal mode) or below (Vertical mode). The **Select Group** mode is automatically activated.



Window and **Zoom** each of the groups separately for viewing two different tissues or anatomic regions.

2. To cancel the **Dual mode**, from the View menu select **Dual**. Then select **Off** from the sub-menu.

Multiple Groups/Stack Reading

The Multiple Groups reading mode of the Viewer allows the viewing of several groups of images simultaneously in more than one Image group in the Viewer window. This mode is particularly useful for the following clinical applications:

- Comparison of pre- and post-contrast studies
- Comparison of old and new studies
- Comparison of studies from different modalities
- Comparison of studies with different protocols within the same modality.

The allowed number of groups depends on the size of the format matrix, at least one image for each group must be displayed in the display area. Therefore, make sure the Window format definition matches the value to be entered.

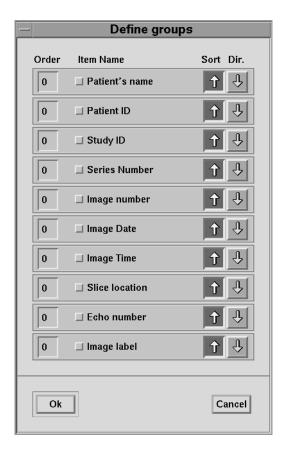
Defining Groups

Groups can be defined by using one of the following methods:

- **Add Group**: This method adds a group based on the selection in the Archive Manager
- **Automatic grouping**: Occurs when more than one series is loaded simultaneously in the Viewer or, if the same series has more than one echo value.
- **Split Groups**: This method defines groups from the images currently in the Viewer. A dialog box opens up prompting the user to enter the desired number of groups. The images will be divided so that the first image is put into the first group, the second image into the second group, and so on.

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• **Define Groups** defines groups from the images currently loaded in the Viewer. The following dialog box opens:



The Define Groups dialog box contains a list of **Item Names** that are used for defining the groups. All images that have the same values as the items selected, will be placed into the same group. The **order** sets the display order of the groups and the **Sort Dir** arrow buttons are used for defining the sort direction (ascending or descending).

Different groups can have different numbers of images, therefore blank frames may appear in groups with fewer images.

Scrolling Groups:

To choose the scrolling mode, use the two blue icons which are the rightmost icons on the Tool Bar.

- To scroll the groups together, click on the icon in the Toolbar or, from the View menu, select **Groups** and from the sub-menu choose **Scroll together**.
- To scroll each group individually, click on the icon in the Toolbar or, from the View menu select **Groups** and from the submenu choose **Scroll separately**.

To **reset the image positions** so that the first image from each group is aligned next to the others, from the **View** menu select **Groups** and from the sub-menu choose **Reset scrolling**.

Display Groups:

The groups can be displayed horizontally or vertically. If the groups are arranged horizontally, they are ordered from left to right and from top to bottom, while if they are arranged vertically, they are ordered from top to bottom and from left to right.

To **change** between the modes, from the **View** menu select **Groups** and from the sub-menu choose **Horizontal** or **Vertical**. The groups will be arranged accordingly.

To swap between two groups:

- **1.** Make sure that the **Select group** mode is active.
- **2.** Click on an image in the first group
- 3. From the View menu, select Swap
- **4.** Click on any image from the second group to be swapped.

To **cancel grouping**, from the **View** menu select **Groups** and from the submenu choose **One Group**. All groups will be combined into one.

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It may be necessary to film only half or third of the images for covering the full scanned region by leaps. A case may occur when a study includes many overlapping images (e.g., for 3D or MIP) and you want to film the original images without overlaps.

Filming Every Second, Third or nth Image

To **skip images**, proceed as follows:

- 1. Set the format of the Viewer to a number of rows equal to or greater than the number of images to be skipped. For example, if every third image is to be filmed, set a format of 3x3, 3x4 or greater.
- **2.** Split the images into the desired number of groups. Refer to the above section on Defining Groups, Split Groups.
- **3.** Click on any image in the group to be filmed; that group will be marked by yellow frames.
- **4.** Send the group to **MasterFilm** by clicking on the **Film** icon on the tool bar.

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Windowing

The **Windowing** functions are used to optimize contrast and brightness of the images. Windowing translates the values of the displayed image into a range of gray levels suitable for optimal viewing and filming. There are nine user-defined preset keys and mouse-driven fine adjustments which enable convenient setting of the window CENTER and WIDTH.

The Window

Pixel values on the image are in the range of -1000 to 3095 for CT. However, the range of pixel values of the interesting organ or tissue is much less. The viewing window, like a house window, restricts the view while enabling concentration on the visible region. By manipulating the window, the density range of the interesting features can be displayed with optimum contrast and brightness. The features having pixel values above the window will be displayed in white and those below in

black; the features with values within the range of the window will be displayed in shades of gray.

The Window Center and Width

The **window CENTER** sets the level of the values displayed; the higher the CENTER, the darker the image.

To view high pixel values, the window CENTER should be set high. Conversely, low pixel values can be viewed best by setting a low window CENTER.

Highlight Dual Alternate Inverse 16 Level Map Automatic Current Set Preset Current P.F Brain IAC Spine Bone Lung Abdomen Liver Air Everything Body

Windowing

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The **window WIDTH** sets the width of the range of values displayed. The larger the WIDTH, the smaller the contrast of the image and the wider the range of values displayed.

If the tissue of interest has a wide absorption range, the window WIDTH should be increased for the window to view the whole tissue. Conversely, a tissue with small absorption differences needs a narrow WIDTH to demonstrate fine contrast details.

Windowing Procedure

To adjust the window CENTER and WIDTH settings of the images, proceed as follows:

- 1. Select the images to be windowed.
- 2. Select one of the preset window keys for approximate setting of the window. The preset windows may be activated from the Windowing menu or by pressing <Alt> + <1-8> on the keyboard. Alternatively, place the mouse pointer over the right, gray levels bar, press the right mouse button and select from the pop-up menu..
- **3.** To finely adjust the window CENTER, drag the mouse up or down with the middle button pressed. Windowing is performed in real-time on the active image, while the rest of the selection is updated during pauses. To adjust the window WIDTH, drag the mouse right or left while pressing the middle button.

∽ Note

To change the preset values, use the Set Preset utility in the Windowing menu

To **copy the window** values of the active frame to another image or group of images:

- 1. Select the image or group of images to be changed.
- 2. Click, while pressing on the **Shift>** key, on the image from which the windowing values are to be copied.
- **3.** From the Edit Menu select **Copy window values**. The windowing values are copied from the active image to the selected images.

Using the Windowing Bars

The **Windowing Bars** are three bars located in the **Tool Box** below the graphical aids. The rightmost bar provides a graphic display of the current window. The bar's full length represents the entire 4096 levels. The location and length of the slider represents the Center and Width, respectively, of the window.

The other two bars modify the current window.

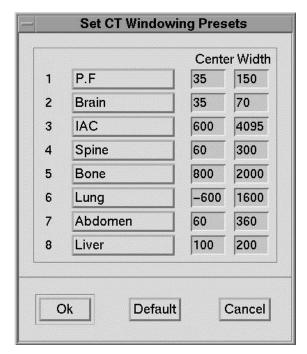
- To quickly change the window Center, drag the slider of the **middle** slidebar up or down.
- To quickly change the window Width, drag the slider of the **left** slidebar up or down.
- To change the Center or Width value by one, place the mouse pointer
 on the respective slidebar (middle one for Center and left one for
 Width) and use the up and down arrows of the keyboard.
- To change the **upper limit** of the window by ten, click on the small up or down arrows at the top of the windowing slidebars.
- To change the **lower limit** of the window by ten, click on the small up or down arrows at the bottom of the windowing slidebars.

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Changing the Preset Windows

To change the preset window values, proceed as follows:

- 1. Set the desired windowing CENTER and WIDTH values on the image.
- **2.** Select Set Preset in the Windowing menu. The following Dialog Box opens:



- **3.** Click on the name of the appropriate window; the values in the text boxes to the right of the name change to the values of the active image. Alternatively, type the desired values in the Center and Width text boxes to the right of the window name.
- **4.** Click on **OK** to keep the new values from now on.
- **5.** If you want to return to the system default values, click on **Default** before clicking **OK**.

Inverse Image

Inverse Image is used to reverse the gray levels of the image and to display a negative image.

To activate the function:

- **1.** Select the images to be inversed.
- 2. From the Windowing menu select **Inverse**, or click on the button in the Tool Bar. The high pixels values will appear in black and the low pixel values in white.
- **3.** To return to the standard image, from the Windowing menu select **Inverse** again and the gray scale reverts to normal.

Dual (Double) Window

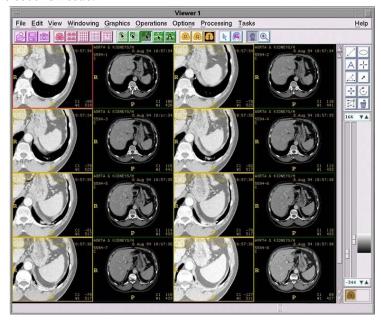
Double window is used to simultaneously display two different density ranges of the image, such as bones and soft tissue.

To activate the function:

- **1.** Select the images to be viewed with dual window.
- **2.** Set the image window CENTER and WIDTH to display a satisfactory image.

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- 3. Click on the button on the Tool Bar or from the Windowing menu select **Dual**. The second window's CENTER (C2) and WIDTH (W2) values are added above the C1 and W1 values in the lower-right corner.
- **4.** Adjust the window CENTER and WIDTH for optimal visualization of the second tissue.



5. To readjust the first window, click on the button in the lower-right corner of the window. Then adjust C1 and W1.

To readjust the second window, click on the button in the lowerright corner of the window. The two windows may also be toggled from the Current option in the Windowing menu.

To remove the Dual window, click again on the button on the Tool Bar or from the Windowing menu select **Dual**. The C2 and W2 labels are erased and the images are displayed only with the "normal" windowing values.

Highlight Window

Highlight window marks, in color, the image regions that have pixel values within a user-defined range. To activate the function:

- 1. Select the images on which tissues are to be highlighted.
- **2.** Set the image window CENTER and WIDTH to display a satisfactory image.
- **3.** From the Windowing menu select **Highlight**. The item is marked on the menu and highlighted CENTER (CH) and WIDTH (WH) values are added above the C1 and W1 values in the lower-right corner.
- **4.** Adjust the window CENTER and WIDTH to color the desired tissues.
- **5.** To readjust the first window, click on the button in the lower-right corner of the window. Then adjust C1 and W1.

To readjust the highlight window, click on the button in the lower-right corner of the window. The two windows may also be toggled from the **Current** option in the Windowing menu.

To **remove** the Highlight window, from the Windowing menu select **Highlight** again. The CH and WH labels are erased and the gray scale returns to normal.

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Alternate Window

Alternate Window switches between two user-set windows. To activate the function:

- 1. Select the images to be viewed with two alternating windows.
- **2.** Set the window for viewing the first tissue.
- 3. Click the pushbutton on the Tool Bar or from the Windowing menu select Alternate.
- **4.** Set the window CENTER and WIDTH for viewing the second tissue.
- 5. Click the pushbutton again. The images are displayed with the first window's windowing values again.
- **6.** To toggle between the two windows, repeatedly click the pushbutton.

Automatic Windowing

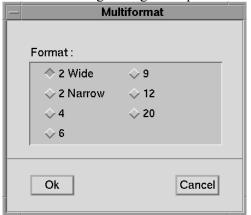
Automatic windowing sets the windowing values according to the window setting of the image displayed in the active window, and copies these values to all other images in the selection. To activate this option:

- **1.** Select the active image.
- **2.** From the Windowing menu select **Automatic**.

Multiformat in Viewing Window

Use the Multiformat function for enclosing a number of images within a single frame before filming or storing.

- 1. Select the images to be grouped in the multiformat frames.
- **2.** From the View Menu, select Multiformat and from the sub-menu Create. The following Dialog Box opens:



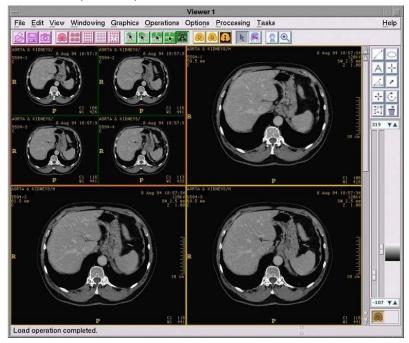
2 Wide generates multiformat frames with two images each, one above the other; used for images with the interesting region wide in the horizontal dimension (body images for example). These images may be zoomed so that the (wide) area of interest takes most of the image area.

2 Narrow generates multiformat frames with two images, one besides the other; used for images with the interesting region high and narrow (head images for example).

4-20 formats display images in 2x2, 2x3, 3x3, 3x4 and 4x5 matrices, respectively.

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3. Click on the number of images to be placed within each frame. Click **OK** to confirm. The multiformat images are displayed and can now be *windowed*, zoomed, stored and filmed.



- To window or Zoom each image separately, click on Subframe mode on the Tool Bar, or from the Edit menu choose Select and select Sub Frames from the sub-menu.
- To window or **Zoom** all the images in a multiformat frame together, select one of the other selection modes.
- **4.** To **cancel the multiformat mode** and to restore the single image mode within each frame:
 - Select the multiformat frames to be converted to single images.
 - From the View menu, select **Multiformat.**
 - From the sub-menu, select **Cancel**.

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Graphics

Overview

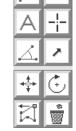
The Graphic functions aid in the analysis of the image by marking and measuring features on the image.

The graphics are activated from the Graphical Tool Box at the right side of the window or from the Graphics menu. They can be applied in all viewing and processing applications. However, in 3D and MIP/Angiography, they function somewhat differently; refer to the respective chapters for details.

Description

The following graphic elements are available:

- LINE draws a straight, curved or freehand line between any two points on the image and marks the distance between them in mm.
- ROI (rectangular, circular, arbitrary curve or freehand)
 encloses an area on the image and measures the area,
 average value and standard deviation of the enclosed
 pixels.



- **TEXT** enables alphanumeric annotation to be placed anywhere on the image.
- **CURSOR** measures the pixel value at its center.
- **ANGLE** draws two joined lines which may be placed along two image features to measure the angle between them.
- **ARROW** points to features on the image.

Manipulations on graphic elements can be selected either from the Graphical Tool Box, or from the Graphics menu. The available manipulations are:

Line

Roi

Cursor

Arrow Text Angle Grid

Profile

Histogram

Operation

Copy to Selection

Delete All Graphics

Сору

Paste

 Move, Rotate, Change Shape (from the Toolbox, and the Graphics/Operation submenu)

•	Overlays ON/OFF and Overlays Color (from
	the Edit menu).

- Graphic elements can be deleted selectively or entirely.
- Graphic elements can be copied from one image to another.

The Graphics menu also contains:

- **HISTOGRAM** that plots the distribution of pixel values in a user defined ROI.
- **PROFILE** for plotting the pixel values along a user defined line.
- **GRID** used for assessment of distances on the image.

Any number of graphical elements can be displayed simultaneously on the screen.

Accuracy of Measurements

Length: the maximum estimated error of the length measurement is:

Length Error (mm) = $2 \times Scan diameter/(Zoom \times Display matrix) + 0.1$

where Display matrix = 1024 x Image height /Screen height Typical values of display matrices:

- Four images on full screen: 450
- Four images in an window on half screen: 170
- 16 images on full screen: 225

Area: the maximum estimated error of the area measurements is:

Area error (mm^2) = Length Error x 2

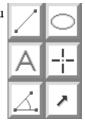
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Using Graphic Elements

Placing A Graphic Element

To place a graphic element (Line, ROI, Text, Cursor, Angle or Arrow) on the image, proceed as follows:

1. Click on the appropriate icon in the Graphical Tool Box, or select the option from the Graphics menu on the Menu bar. Line and ROI icons show one of the shapes available; to select another shape, click with the right mouse button on the icon and choose the required shape from the displayed icons.



- **2.** The pointer changes to the shape of a pencil.
- **3.** Move the pointer to the image feature, and do as follows:
 - To **place a Cursor** on the image, click on the point to be measured.
 - To **place Text** on the image, click on the starting position of the text, then type the text and when finished, click again or press **<ESC>** on the keyboard.
 - To place an oval (elliptic) ROI on the image, press the mouse button on the center of the feature to be measured and drag the mouse in any direction.
 - To place a Line, ROI (except oval), Angle or Arrow on the image, press the mouse button on the starting point and drag in the desired direction to draw the graphic element.
 - To activate a Grid, Profile or Histogram, from the Graphics menu select Grid, Profile or Histogram. Then select the desired option from the sub-menu.

Changing an Existing Graphic Element

To change existing graphic elements:

- 1. Click on the appropriate operation Icon (Move, Rotate and Change Shape) or select the operation from the Operations sub-menu in the Graphics menu.
- **2.** Click on the graphic element that is to be changed. Small square handles appear near the outline of the graphic.
- **3.** Click on one of the handles and modify as required.
- **4.** To change the layout, or style of the Grid, Profile or Histogram, from the Operations sub-menu in the Graphics menu select Grid (Profile, or Histogram) and then select the desired option from the sub-menu that appears.

Monochrome and Inverse Overlays

This function is used to preview the overlays in the gray shades in which they will be filmed.

To **change the color of the overlays** (lines, text, cursors, arrows, angles and ROIs) from color to monochrome or to inverse monochrome, select **Overlays Color** from the Edit menu and from the sub-menu choose **Monochrome or Inverse**. The inverse monochrome shades are used if the overlays are not clearly distinguishable from the image.

To **revert** the overlays to color, select **Overlays Color** from the Edit menu and choose **Color** from the sub-menu.

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Copying Graphic Elements

There are two methods available for copying graphic elements from one image to another:

Copy and Paste In this method you first select an element to be

copied and then select the image to which it is to

be copied.

Copy to Selection In this method you select a number of images and

then the element that you want copied to them. (This method is available **only** in the Viewer.)

Copy and Paste

To **copy and paste** a graphic element:

- 1. From the Graphics menu select Copy. Note that the cursor shape changes to a pencil and handles appear near all elements that can be copied.
- **2.** Click on any handle of the element you want to copy (this selects the element).
- **3.** Click on the image that you want to copy the element to.

Copy to Selection

This method may be used only in the Viewer.

- 1. Select the images to which you want to copy the element.
- **2.** From the Graphics menu select Copy To Selection. Note that the cursor shape changes to a pencil and handles appear near all elements that can be copied.
- **3.** Click on any handle of the element you want to copy. Note that a copy of the element appears in each selected image.

Deleting Graphic Elements

To delete a graphic element, proceed as follows:

- 1. Click on the **Delete** icon in the Graphical Tool Box or select Delete from the Graphics menu. The handles of the graphic elements are revealed.
- **2.** Click on the handle of the element to be deleted; the element is erased.

To delete all graphic elements, from the Graphics menu select **Delete all graphics**.

Temporarily Removing Overlays

To **temporarily remove all overlays and text** in order to reveal obscured image portions, from the **Edit** menu select **Overlays ON/OFF**. All overlays including patient data, scan information, text, graphic elements and statistics data are blanked out.

To reinstate the overlays, from the Edit menu select Overlays ON/OFF again.

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Graphic Elements Operation

LINE

Lines are used to measure distances on the image. Several line shapes are available:

- STRAIGHT line is used to measure the distance between two features on the image.
- CURVEDFREEHAND lines are used to measure the length of features of any arbitrary shape.

STRAIGHT LINE



- 1. Click on LINE. If another line shape is drawn on the button, click on the icon with the right mouse button and select the straight line from the list of icons. Alternatively, select Line from the Graphics menu and choose Straight from the sub-menu.
- **2.** Move the pencil pointer to the first point and click. Drag the end of the line to the second point and release the mouse button. The distance between the two points is displayed.
- 3. To move an existing line, click on the Move icon on the Graphical Tool Box or select Move from the Graphics/Operation sub-menu. Move the pointer to one of the line's handles (at its either end) and drag it to another location.
- 4. To change the placement of one of the lines ends, click on the Change Shape icon in the Graphical Tool Box or select it from the Graphics/Operation sub-menu. Move the pointer to the end to be moved and drag it to the new location.

CURVED LINE (Bezier)



- 1. Click on the LINE icon with the **right** mouse button and select **CURVED LINE**. The pointer is transformed into a pencil. Move the pointer to the beginning of the line, click the **left** mouse button and move along the feature to be measured.
- 2. The line should overlay the feature; if the line begins to deviate, click again the mouse button to create a fixed point and continue moving. Repeat until the line covers the whole feature to be measured. Double-click to finish drawing (or press < Esc> on the keyboard). The line is smoothed.
- **3.** To delete the last segment, press **Backspace** on the keyboard. Pressing **Backspace** will delete the segments in reverse creation order.
- 4. To correct the line, click on the Change Shape icon in the Graphical Tool Box or select it from the Graphics/Operation sub-menu. The pivot points on the curve become visible; drag the deviant ones to their correct places. Or click on the line between two pivot points to add a new pivot point and drag it to its new location.
- 5. To move an existing line, click on the Move icon on the Graphical Tool Box or select Move from the Graphics/Operation submenu. Move the pointer to one of the line's handles and drag it to another location.
- 6. To continue drawing the curve beyond the last point, click on the Curved Line icon and click on the end-point, then continue drawing the curve as given in the steps above.

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FREEHAND LINE



- 1. Click on the LINE icon with the **right** mouse button and select **FREEHAND LINE**. The pointer is transformed into a pencil. Move the pointer to the beginning of the line, and click the left mouse button. Now move the pencil along the feature you are measuring and click the left mouse button to end the line.
- 2. Draw carefully along the feature; if the line begins to deviate, press <Backspace> on the keyboard repeatedly to delete the last points. To finish drawing, release the mouse button and click.

 If you want to continue the line beyond the end point you have marked, click on the LINE icon again and mark the last point as the starting point of the new line by clicking on it. Then repeat the above.

Solution Note: If the line is not exact enough, delete it and start again.

3. To move an existing line, click on the Move icon on the Graphical Tool Box or select Move from the Graphics/Operation submenu. Move the pointer to one of the line's handles and drag it to another location.

6

ROI (Region of Interest)

ROIs (elliptic, rectangular, curved and freehand) are used to measure area, average pixel value and standard deviation of pixel values of a user-defined region-of-interest.

To **select another ROI shape**, click on the icon with the **right** mouse button and select from the list of icons an elliptic, rectangular, curved or freehand ROI. For better coverage of the interesting area, use the curved or freehand ROIs.

Alternatively, select **ROI** from the Graphics menu and choose the desired ROI shape from the sub-menu.



Drawing Elliptic or Rectangular ROI

- 1. Move the pencil pointer to the feature to be measured; to the center of the feature for elliptic ROI and one of its corners for rectangular ROI.
- **2.** Press the mouse button and drag the mouse to enlarge/contract the ROI to cover the region of interest on the image.
- 3. To move an existing ROI, click on the Move icon in the Graphical Tool Box or select Move from the Graphics/Operation sub-menu. Move the pointer to one of the ROI's handles and drag it to another location.
- 4. To change the size of the ROI, click on the Change Shape icon in the Graphical Tool Box or select Change shape from the Graphics menu. Move the pointer to the handle nearest the side to be changed and drag to cover the interesting feature.
- **Note:** This operation is not available for FREEHAND ROI.
 - 5. To **rotate** the ROI, click on the **Rotate** icon and drag a handle to rotate the ROI so that it conforms to the tissue to be measured.
- **Note:** This operation is available for elliptic and rectangular ROIs only.

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Drawing Curved or Freehand ROI

Drawing and manipulations of Curved and Freehand ROIs are similar to the Curved and Freehand lines, respectively (see previous section). The Curved ROI is closed by double clicking, and the Freehand ROI is closed by one click.

Change Shape of Freehand

To change the shape of a Freehand ROI

- 1. Click the **FREEHAND LINE** icon.
- **2.** While holding down the **Shift**> key, click on the ROI where you want to start changing the shape.
- **3.** Draw the line as described above.
- **4.** Indicate the end point of the new ROI by clicking on it.

Measuring Average Pixel Value, Standard Deviation or Area of a Feature

- **1.** Draw the appropriate ROI around the feature. The following data is displayed with the ROI:
 - AR: Area of the ROI in mm2
 - AV: Average value of image pixels enclosed by ROI
 - SD: Standard Deviation of values in ROI
 - ED: Effective Diameter (diameter of circle that has the same area as the ROI)

Only part of the data may be displayed. To select which data to display, use ROI Values in the Options menu.

- **2.** If the displayed data covers an interesting feature of the image or it may be confused with another graphic element, click on the **Move**
 - icon. Place the pointer on the handle to the left of the data text and drag it to another location, where there is no other graphic element to confuse or hide the data.

- **3.** To measure any feature of the image, overlay it as closely as possible by the ROI as follows:
 - Select the appropriate ROI shape (elliptic or rectangular for regular tissues, curved or freehand for any arbitrary shape).
 - To measure **average** and **standard deviation** of image features, include the ROI, with its outline, inside the feature.
 - To measure **area**, overlay the boundary of the feature by the ROI outline. With elliptic or rectangular ROIs, adjust the ROI so that feature areas excluded from ROI are compensated by approximately equal areas that do not belong to the feature.
 - The pixels overlaid by the ROI contour are included in the ROI calculations.

Summing ROIs

When the region of interest is made up of several individual ROIs, you can get a summation of the ROIs by:

- **1.** From the Graphics menu select **ROI**.
- **2.** From the ROI sub-menu select **Sum**. Note that the cursor changes its shape to a pencil.
- **3.** Click on the handles of the ROIs you want summed. Note that the values of the summed region appear in the lower left corner of the image.

Subtracting ROIs

When one region of interest is completely enclosed within another, the enclosed ROI may be subtracted. Proceed as follows:

- **1.** Draw the two ROIs.
- 2. From the Graphics menu select **ROI**. Then from the ROI sub-menu select **Sum**.
- **3.** Click on any handle of the enclosing ROI.
- **4.** From the Graphics menu select **ROI**. Now from the ROI sub-menu select **Subtract**, and click on any handle of the enclosed ROI. Note that the area of the region appears in the lower left corner of the image.

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CURSOR



Cursor is used to measure the values and XY coordinates of image pixels.

- Click on the Cursor icon in the Graphical Tool Box, or from the Graphics menu select **Cursor**. The pointer changes to the shape of a pencil. Move it to the desired position and click. The CT value and the coordinates of the pixel at the cursor's center are displayed. On a Lateral Surview the height (Y) and table position (Z) are displayed; on AP or PA Surviews, the lateral distance (X) and table position (Z) are displayed.
- To **move** an existing cursor, click on the **Move** icon in the Graphical Tool Box or from the Graphics/Operation sub-menu select Move. Move the pointer to the center of the cursor and drag it to another location.



⚠ Warning

On Surview images, the X and Y coordinates are inaccurate and may be used for reference only. This is because the Surview is a planar projection and the magnification factor of each object varies with its distance from the focal spot, similar to conventional X-ray radiography.

- 1. The XY coordinates are displayed in the Viewer and Scan Viewer only.
- 2. Partial display of the cursor data may be set in Cursor Value . . . in the Options/Display Utilities menu. A crosshair may be displayed on Surview images instead of the usual small cross.
- 3. The coordinates origin may be set in **Coordinates Origin** . . . in the Options/Display Utilities menu. Three modes are available: Lower-left corner (of the image frame), Center of Frame, and Center of Image (equivalent to the scanner center of rotation).

ARROW



Arrows are used to point to features of interest on the image and to link features to the corresponding user-typed texts, as described below:

- 1. To **point to a feature** on the image, click on the **Arrow** icon in the Graphical Tool Box or from the Graphics menu select **Arrow**.
- **2.** Move the pencil pointer to the feature on the image. Click the mouse and drag the arrow to the location where you want the text to appear.
- **3.** To **add text** at the arrow tail, use the TEXT function.
- 4. To move the arrow head or tail, click on the Change Shape icon in the Graphical Tool Box or from the Graphics/Operation sub-menu select Change shape. Move the pointer to the end to be moved and drag it to another point.
- **5.** To **reposition** an existing arrow, click on the **Move** icon in the Graphical Tool Box or from the Graphics/Operation submenu select **Move**. Move the pointer to one of the handles and drag it to another location.
- **6.** To annotate a feature, proceed as follows:
 - Type the explanatory TEXT in a free space on the screen (see **TEXT**).
 - Click the **Arrow** icon; drag the arrow from the text to the feature.

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TEXT



Text is used to superimpose annotations on the image.

To superimpose annotations on the image:

- 1. Click on the **Text** icon in the Graphical Tool Box or from the Graphics menu select **Text**. Move the pencil pointer to the place the text will begin and click again.
 - Type the desired text. To type a capital letter, press **Shift>** and the letter key simultaneously. To begin a new line, press **Enter>**. When finished typing, click anywhere on the image or press **Esc>** on the keyboard.
- 2. To move the text, click on the **Move**Box or from the Graphics/Operation sub-menu select **Move**. Move the pointer to the text handle (the small square at the left of the first letter) and drag it to another location, close to the feature it describes without hiding interesting features.
- **3.** Use the **Arrow** to point from the text to the feature it describes, if they are far away from each other.

ANGLE



Angle is used to measure the angle, in degrees, between body features, as described below:

- 1. Click on the **Angle** icon in the Graphical Tool Box or from the Graphics menu select **Angle**.
- **2.** Move the pencil pointer to one of the features, and click on the edge farthest from the feature angle to be measured. Move the end of the line to the intended position of the angle vertex, and click the mouse button

Move the end of line to the edge of the second feature, and click. the mouse button.

The angle value, in degrees, is displayed near the angle vertex.

- 3. To change the placement of the vertex or a line, click on the **Change**Shape icon in the Graphical Tool Box or from the
 Graphics/Operation sub-menu select **Change shape**. Move the pointer to the vertex or line end that is to be moved and drag it to required point.
- 4. To reposition an existing angle, click on the Move icon in the Graphical Tool Box or from the Graphics/Operation sub-menu select Move. Move the pointer to one of the handles and drag it to another location.

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Grids

The **Grid** facilitates assessing distances between objects in the image. You have a choice between three types of grids:

- Coordinate
- On Image
- Scales

COORDINATE GRID

This grid consists of two orthogonal scales overlaid on the image. To overlay the coordinate grid on the image:

- **1.** From the Graphics menu select **Grid**. Then from the Grid sub-menu select **Coordinate**.
- 2. To move the origin of the grid, click on the Move icon. Note that the cursor shape changes to a pencil. Drag the origin of the grid to its new position.
- **3. To remove the grid** select **Grid** from the Graphics menu and then from the Grid sub-menu select **Off**.

GRID ON IMAGE

This grid consists of a mesh overlaid on the image. To overlay the grid on image:

- 1. From the Graphics menu select **Grid**. Then from the Grid sub-menu select **On Image**.
- **2. To change the spacing between the mesh lines**, first select the image with the grid. From the **Grid** sub-menu select **Spacing**. Type the spacing in the Dialog Box that appears and click on the **OK** button.
- **3. To remove the mesh grid** from the Graphics menu select **Grid** and then from the Grid sub-menu select **Off**.

SCALES

When activated, four scale lines appear on the sides of the image. To display the scales:

- **1.** From the Graphics menu select **Grid**. Then from the Grid sub-menu select **Scale**.
- **2. To change the scale between the tick marks**, first select the image with the grid. From the Grid sub-menu select **Spacing**. Type the scale in the Dialog Box that appears and click on the **OK** button.
- **3. To remove the scales**, from the Graphics menu select **Grid** and then from the Grid sub-menu select **Off**.

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Histogram

Histogram enables you to plot the pixel distribution in a ROI of any shape. To **obtain a histogram**:

- 1. From the Graphics menu select **Histogram**. Then from the Histogram sub-menu select **Oval**, **Rectangle**, **Spline** or **Free**. Click on the image and draw an ROI (refer to "ROI (Region of Interest)" above for details). The histogram of the pixel values distribution is displayed on the image.
- 2. To enlarge a portion of the histogram, from the Graphics menu select Histogram and then from the Histogram sub-menu select Enlarge Plot. Click on the starting point of the area that you want to enlarge. Drag across the area to the end point. An enlarged view of the selected area is displayed.
- **3.** To restore an enlarged area to its original size, from the Graphics menu select **Histogram** and then from the Histogram sub-menu select **Restore Original**. Click anywhere on the image that includes the plot. The plot is reduced to its original size.
- **4. To examine a point in the plot**, from the Graphics menu select **Histogram** and then from the Histogram sub-menu select **Examine**. A line appears on the image. Drag the line to the required point and release the mouse button. The values are displayed below the line.
- 5. To delete the histogram, click on the Delete icon, then click on one of the handles of the histogram.

Profile

Profile enables you to plot the pixel values along a line that you draw on the image.

- 1. From the Graphics menu select **Profile**. Then from the Profile submenu select **Draw**. Draw the profile line in the same way that you would draw a line element (refer to "LINE" above for details). A plot of pixel values along the line appears on the image.
- 2. To change the line orientation or length, click on the Change Shape icon and drag the line points to the new location.
- **3. To zoom the plot**, from the Profile sub-menu select **Zoom**. Drag the mouse upward to enlarge the plot, and downward to reduce the plot.
- **4. To move the plot**, from the Profile sub-menu select **Pan**. Drag the pencil in the direction you want to move the plot (up, down, left or right).
- **5. To change the thickness of the profile line**, from the Profile submenu select **Thickness**. Move the pencil upward to increase the thickness, and down to decrease the thickness. The average value of the plot is displayed.
- **6. To examine a point on the plot**, from the Profile sub-menu select **Examine**. A line appears. Drag the line to the desired point. The value appears displayed below the line.
- 7. To delete the profile, click on the Delete icon, then click on one of the handles of the profile line.

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Display Options

The **Display Utilities** found in the Options menu provides a number of options for selecting items you want to have displayed. These are:

ROI Values This allows selecting which of the ROI values (area,

average and/or standard deviation) to be displayed near

the ROI.

Ticks If selected, all lines are displayed as scales.

Text Background If selected, then all text in the image appears on a

background that helps to distinguish it from the image.

Titles Off All the title items will be removed from the displayed

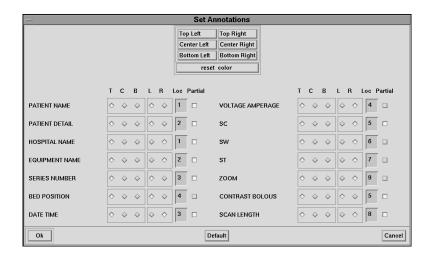
images.

Titles Enables selection of which title items to display on the

images and sets their position on the image.

Titles

When **Titles** is selected, the following dialog box opens:



Titles can appear in one of six locations within the image window. These locations are: Top Left, Top Right, Center Left, Center Right, Bottom Left, Bottom Right.

The following check boxes may be selected for each parameter in the image titles:

Т: Тор	Only one of
C: Center	these can be
B: Bottom	selected

L: Left	Only one of
R: Right	these can be selected

Loc: The number defines the line number of the parameter in the specific corner.

Partial: On images that are smaller than 350² pixels, only part of the titles appear. Checking the Partial box of a parameter in the table displays that parameter on the small images, while the unchecked (white Partial box) items are not displayed.

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MASTERFILM

Overview

The **MasterFilm** is used for viewing, rearranging, *windowing* and zooming images prior to sending them to be printed.

The **MasterFilm** may be activated from the File menu of all applications. It operates similarly to the Viewer application with minor differences.

Some of the advantages provided by the **MasterFilm** are:

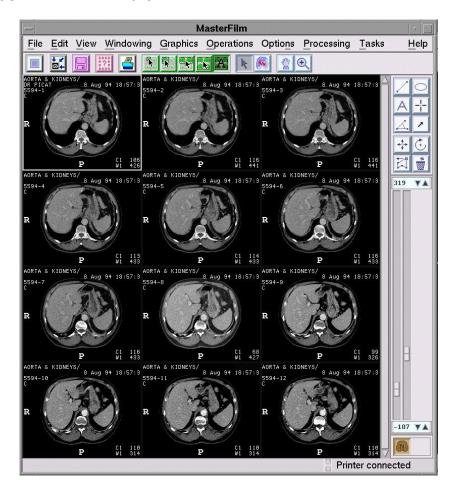
- The same image can be filmed with different zoom and *window* parameters in the Dual mode.
- Better organization and economy of films may be achieved by filming in the Multiformat mode.
- Measurements and annotations (done with graphic elements) may be added or deleted from the images.



Caution

Measurements on 3D images are not the same as in the 3D application; the measurements are in the screen plane and not on the three-dimensional curved surfaces.

MasterFilm Window



The **Title Bar** contains the name of the application (Film). It is also used for moving the window by dragging it with the left mouse button pressed.

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The **Menu Bar** consists of several menu selections (shown in the shaded headings below). These menu selections, when clicked, display a drop-down list of functions that can be performed in the MasterFilm application.

File	Edit	View	Operations	Windowing
Add Images	Reset All	One Image	Select	(see Ch5, Vol1)
Add Groups	Сору	Four Images	Pan	
Save Image(s)	Add to Clipboard	Sort Images	Zoom	
Save As	Paste	Multiformat	Enhance	Graphics
Print	Swap	Dual	Flip	(see Ch6, Vol1)
Clear Film Queue	Duplicate	Groups	CR/RF/NM Full Resolution	
Printer	Delete Images	Fit Window		
Queue Manager	Select All	Add Blank Images	Options	Processing
Logout	Select None	Image Parameters	Do Not Mix Patients	(see Ch2, Vol1)
Close	Select	Add Parameters Frame	Automatic Filming	
	Copy Windowing	Show Grayscale	Re-Align Pages	
	Copy Zoom	Film Format	Enhancement Square Size	Tasks
	Copy Enhancement	Film Size	Reset to Defaults	(see Ch2, Vol1)
	External Clipboard		Display Utilities	
	Overlays Color		(printing options)	
	Overlays ON/OFF			

General **File** functions are described in **Chapter 2, Vol. 1 – System Description**. The **Printer** selection allows you to select from several printers or imagers, if they are connected, and other printing operations. If there any Imager problems, use the **Clear Film Queue** function.

The Edit functions are the same as in Chapter 5, Vol. 1 - Viewer.

General **View** functions are described in Viewer, Chapter 5. This menu includes the ability to set the format, multiformat and dual modes; set the film format; and set the film size (depending on printer capabilities).

The **Operations** functions are the same as in **Chapter 5**, Vol. 1 - Viewer.

Options (described later in this chapter) includes various film/printer parameter selections and settings, and allows selective display of ROI measurement data, Reset to Defaults of the parameter settings, and Printer Settings.

The **Tool Bar** contains the following icons for activating the frequently used functions.



The icons (from left to right) are:

- **Exit** for closing the window; the application remains invisible in the background with all the images intact.
- **Reduce size** to reduce the MasterFilm window to a small monitor in the lower-left corner of the screen.
- Save for saving the selected images in the Archives.
- Number of images on film which enables you to change the format
 of the film; the same format should be set manually on the keypad of
 the Imager itself.
- Print page for sending to the Imager or printer the currently displayed page (may be activated in the Film Page display mode only).
- Selection modes:

Sub-frames (used in Multiformat) to select one or several images in a multiformat frame.

Frames(s) to select one or several frames.

Groups to select one of two groups of images, such as one of the two groups in DUAL mode.

Whole window to select all the images in the window.

All images to select all the images in the MasterFilm.

- **Select** for deselecting the graphics, zoom and pan buttons to enable selection of images.
- **Enhance** to sharpen or smooth the images.
- Pan for moving the selected images within the window.
- **Zoom** for magnifying and minifying the selected images.

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The **Message Line**, located at the bottom of the screen, displays on-line help and system messages. In the right corner the current printer settings are displayed.

The **Scrollbar**, the leftmost one on the right side of the window, is for scrolling through the images and film pages.

The **Graphics Tool Box** on the right side of the window contains the graphical aids for annotating and measuring features on the images.

For detailed operation instructions of the graphic elements, refer to **Chapter 6**, **Vol. 1 - Graphics**.

A **pop-up menu**, which when invoked, appears on the image and can be used to activate the most commonly used functions and tools. To invoke the pop-up menu, place the pointer on any one of the images and click the **right** mouse button.

Filming Images

In all applications there is an icon, **Film** , for sending the selected images, window or series to the MasterFilm. Alternatively, filming options are accessible from the applications' File menu. The images filmed in the applications are added to the images already in the MasterFilm.

To film images from an application:

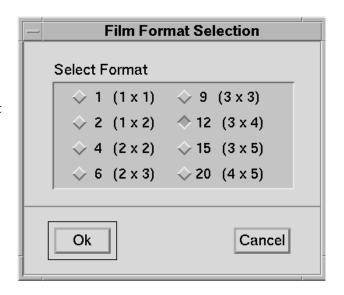
- 1. Click on the appropriate selection mode (sub-frame, frame, window, etc.); in some applications, only the displayed image can be filmed.
- 2. Click on the Film icon on the Tool Bar or select Film Images from the File menu. In the MPR application, the **Film series** option may be selected for filming a series of user-defined cuts.
- **3.** Activate **MasterFilm** in the File menu, rearrange and adjust the images and print the film pages. Refer to the next sections for more details.

Film Format

To change the film format, click on the

Film Format icon on the Tool Bar or select Set Film Format from the View menu. The Dialog Box shown at right opens up.

Click on the desired format, then on **Ok**.



MasterFilm Monitor



The **MasterFilm Monitor** (example shown at left) allows you to display a reduced-size film page. It is activated using the Reduce Size

button from the MasterFilm application's Tool Bar.

The monitor's default location is in the lower-left corner of the display, but you can drag it to any other location.

The monitor's header identifies: whether the setting is **M**anual or **A**uto filming; the currently displayed page out of the total number of pages; the film format; and the printer name.

Click inside the Monitor's film image field to return to the full-size MasterFilm display.

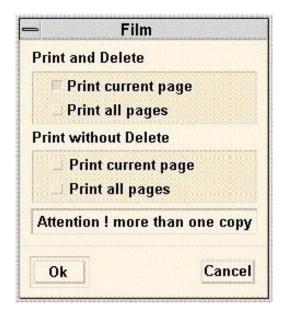
When all applications are closed, the Archive Manager is not automatically open. On the Title of the minimized MasterFilm, click the Right Mouse button and select Close from the pop-up menu. Alternatively, press Alt-F4.

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Print Film (with and without Delete)

From any of the applications, use one of the Filming methods given in the section *Filming Images* above (or use the File menu's **Add** selection) to send the images to be filmed to the MasterFilm.

When desired, send the images from MasterFilm to the printer or imager by clicking on the Print icon. Alternatively, from the File menu select **Print...** The following Dialog Box appears:



2. From the above dialog box, you can print the current (or all) film pages and either automatically delete the images, or print without deleting the images.

7

Selecting Another Printer

The system may be connected to several printers or imagers. To select a printer other than the printer currently set for your system:

- **1.** From the File menu select **Printer...**. This opens the Print Dialog Box presenting you with a list of the available printers.
- 2. Select the desired printer from the list and then click on Ok.

Clear Film Queue

If there are any problems with the Imager, the films that are waiting to be printed (in the internal system spooler) can be deleted as follows:

From the **File** menu, select **Clear Film Queue**. A prompt appears with a confirmation message. Click on **Ok** to delete the films. Click on **Cancel** to exit without deleting.

Modifying Film Parameters



Click on the **Options** selection on the main menu bar to drop down selections that allow you to modify film parameters. Part of the menu is shown at left. The rest of the menu (described on the next page) presents a list of modifiable parameters specific to the film printer that is currently active.

Do Not Mix Patients! (the default mode) – When activated (box is yellow), if there are images from a previous patient already on the page, and you send images of a new patient to MasterFilm, a new film page is started.

Automatic Printing – When activated, once a page is filled it is automatically sent to the film printer.

Enhancement Square Size – The size of the square over which the enhancement is performed when the Enhance operation is activated.

Reset to Defaults – Reverts to the default film format.

Display Utilities – Drops down a menu that offers various display options.

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The following is a list of many of the printer parameters that may be modified.

The list below is representative, and only those parameters associated with the current printer setting will be displayed when you select **Options**.

Film format Format of the printed film.

Film orientation Portrait or Landscape.

Print priority Priority of the film in the print queue.

Number of copies Number of copies to be printed.

Color option Color or Black & White (B/W).

Medium type Clear Film, Blue Film, etc.

Film destination Magazine or Processor.

Annotation format Determines how film annotations are printed.

Magnification type Cubic, Bi-Linear, etc.

Smoothing type Image smoothing type.

Border density The print density of the image border. **Empty image density** The print density of an empty image.

Trim Whether to print image with or without a frame.

Polarity Print normal or reverse image.

Image Manipulations

Image Selection



The image selection modes operate exactly like in the Viewer application. Refer to **Chapter 5**, **Vol. 1 - Viewer** for more details.

- 1. The selected images are enclosed within a gray frame.
- 2. The active image is enclosed within a **white** frame. Operations are performed in real-time on the active image, while the rest of the selection is updated during pauses.

Rearranging Images In The MasterFilm

Images can be moved from one frame to another by using the Cut, Copy, Paste and Swap functions.

To **move** a selection to another place in the MasterFilm:

- 1. Select the image or group of images to be moved.
- 2. Press <Ctrl> + <X> on the keyboard to cut the selection out from the present place. Alternatively, from the Edit menu select Cut. The selection is now deleted from the window and is stored on the clipboard (temporary storage memory).
- **3.** Click on the frame where you want to insert the selection.
- **4.** Press **<Ctrl>** + **<V>** to insert the selection or from the **Edit** menu select **Paste**.

The selection is inserted from that frame onward. The rest of the frames will be pushed down or moved to the right.

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To swap between two images:

- **1.** Click on one of the images to be swapped.
- 2. Press <Ctrl> + <W> or, alternatively, from the Edit menu select Swap.
- **3.** The pointer changes to **3**.
- **4.** Click on the second image to be swapped. The two images are now exchanged.

The two images have to be visible at the same time.

To copy a selection to another place in the Viewer:

- 1. Select the image or group of frames to be copied.
 - Press **<Ctrl>** + **<C>**, or from the Edit menu select **Copy**. The selection is copied onto the clipboard and is not deleted from the screen.
- **2.** Click on the frame where you want to insert the selection.
- **3.** Press **<Ctrl>** + **<V>**, or from the **Edit** menu select **Paste**. The selection is inserted from that frame onward. The rest of the frames will be pushed down or moved to the right.

Add Parameters Frame

The image parameters can be displayed as an image in the display area and can be filmed:

- 1. Click on the image whose parameters are to be inserted.
- **2.** From the **View** menu, select **Add Parameters Frame**. The Image Parameters will be displayed in the image window to the right of the selected image and all the images following the selected image will be shifted by one space.
- **3.** To remove the Image Parameters Frame, select it and from the EDIT menu click on DELETE IMAGE(S). Alternatively press **<Ctrl>+d** on the keyboard.

Add Blank Image

To insert a blank image frame to the display area:

- 1. Click on the frame where you want to insert the blank image.
- **2.** From the Edit menu, select Add Blank Image. All the images from the selected image and onwards will be shifted by one space and a blank image will be inserted in the current frame.
- **3.** To remove the Blank Frame, select it and from the EDIT menu click on DELETE IMAGE(S). Alternatively press <Ctrl>+d on the keyboard.

Text and graphics may be inserted in the blank frame and can be filmed; however, saving to archives is not possible.

Zoom And Pan



Zoom is used to magnify or reduce the size of the image.



Pan is used to move the image for centering the feature of interest in the image frame.

For details, refer to Chapter 5, Vol. 1 - Viewer.

Enhance



Enhance is used to sharpen or smooth images. It is activated by clicking the **Enhance** pushbutton on the Tool Bar or, from the **Operations** menu.

For details, refer to Chapter 5, Vol. 1 - Viewer.

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Windowing

Refer to the section on *Windowing* in Chapter 5, Vol. 1 - Viewer.

Graphic Elements For Measurements And Annotations

All graphic elements are available for measuring and annotating features on the images. For details, refer to **Chapter 6**, **Vol. 1** - **Graphics**.

Flip Image

Images can be flipped from left to right or up and down. For details, refer to **Chapter 5, Vol. 1 - Viewer**.

Scrolling Through the Images

Scrolling is performed on a page-by-page basis where the page is a single sheet that can be sent to the Imager.

If multiple groups are defined, the scrolling can cause a large number of gaps (empty frames) to appear on a page. In the **Options** menu if the auto **Re-Align pages** is on, then the first image from all groups will always be aligned with the first row of the first page.

Gray Scale

To display (and/or print) a gray scale on the image in the MasterFilm, from the View menu select **Show Grayscale**.

Dual Images

Dual Images replicates each image in the Viewer and displays it to the right or below the original.

From the **View** Menu, select **Dual**. A sub-menu appears. Select **Horizontal** or **Vertical** mode, depending on the film format.

The images are then duplicated to the right of the original image (Horizontal mode) or below (Vertical mode). The SELECT GROUP mode is automatically activated.

Window and **Zoom** each of the groups separately for viewing two different tissues or anatomic regions.

To cancel the Dual mode, from the View menu select **Dual** and then select **Off**.

Sorting Images

The images are initially displayed in the order that they were listed in the Archive Manager. In some cases it may be necessary to view the images in a different sorting order. To do this, from the **View** menu, select **Sort Images**. For further details, refer to **Sorting Images** in **Chapter 5, Vol. 1 - Viewer**.

Multiple Groups/Stack Filming

The Multi-Groups viewer filming mode allows the viewing of several groups of images simultaneously in the Viewer window, while enabling scrolling and manipulation of each group independently. See **Chapter 5**, **Vol. 1 - Viewer** for more details.

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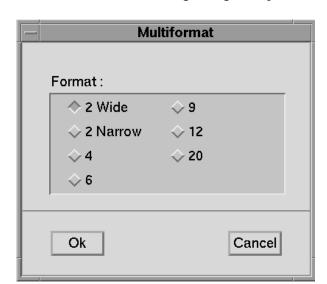
Multiformat

Use the Multiformat function for printing a number of images within a single frame on film. Typical uses are:

- Spine images in which the interesting area takes only a small part of the frame area. The images may be zoomed by a factor of 1.5-2.5 and filmed in a multiformat of 4 per frame.
- The last images in head studies where the images at the top of the head are small.

To film images in Multiformat:

- 1. Select the images to be grouped in the multiformat frames. In the **All** mode, all the images will be displayed in multiformat.
- **2.** From the View Menu select Multiformat and from the sub-menu select **Create**. The following dialog box opens:



- **3.** Click on the number of images to be placed within each frame. Click **Ok** to confirm. The multiformat images are displayed and can now be stored and filmed.
- **4.** To cancel the multiformat mode and to restore the single image mode within each frame:
 - Select the multiformat frames to be converted to single images.
 - From the View menu select Multiformat.
 - From the sub-menu select Cancel.

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Bolus Pro Ultra (Option)

Overview

The BolusPro Ultra function maximizes the efficiency of CT scans that are enhanced through the use of a contrast agent.

When a contrast agent is used to enhance the visualization of organs, the enhancing effect varies over time as a function of the agent's concentration in the blood. Ideally, the **Clinical scan** will be performed when the level of the contrast agent is at its peak enhancement.

BolusPro Ultra is designed to help the user time the Clinical scan with precision. This is done by preceding the Clinical scan with a **Tracker scan**.

The **Locator** scan is a fused Axial scan that is used to locate an ROI and to set a threshold of contrast agent attenuation at that ROI position. During a BolusPro Ultra operation, the Tracker scan tracks the contrast agent level at the selected ROI, and, when the threshold is exceeded, the Clinical scan is automatically started.

The BolusPro Ultra function provides the following advantages:

- Precise control over scan timing in relation to contrast agent level.
- Reduced quantity of contrast agent (due to higher timing accuracy).
- The ability to improve the differentiation between the blood cycle phases (such as the Arterial phase, Portal and Venous phase, and organ uptake).

Hardware Requirements for Bolus Pro Ultra

A Power Injector, manually controlled by the operator, is the minimum requirement.

Optionally, the injector may be equipped with scan trigger. Then the time from injection start is counted down, and the scanner is automatically initiated after a preset interval. This delay helps save patient irradiation at the beginning of the injection, before the time when the Contrast agent can be viewed.

The use of the injector scan trigger feature requires the Mx8000 to be equipped with the Spiral Auto Start (SAS) option, in conjunction with either a Liebel-Flarsheim 9000 or MedRad Envision power injector.

Features

The main software features of the BolusPro Ultra function are as follows:

- Automatic scan triggering based on threshold value.
- Scan start based on injector trigger (SAS is then pre-requisite).
- Protocol planning and modifications are available for three basic BolusPro Ultra scans: Locator (fused Axial), Tracker (fused Axial) and Clinical (Helix).
- The contrast level threshold is operator-defined; the system default is 150 H.U.
- A programmable time delay is available between start of the injection and the start of the **Tracker** scan.
- The start of the **Clinical** scan is automatically initiated when the programmable threshold is reached.
- A manual override is permitted, thus terminating the **Tracker** scans and initiating the **Clinical** (helical) scan sequence.
- A programmable time delay is available between termination of the **Tracker** scan and the start of the **Clinical** study.
- Additional **Clinical** helix scans can be planned, if desired; they also are automatically started.

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- Up to 5 ROIs can be established for **Tracker** scans. (Note that only the threshold determined by the first ROI terminates the **Tracker** scan and initiates the **Clinical** (helical) run. The information for other ROIs is recorded but does not affect operation.)
- The ROI's densities are calculated and displayed at intervals equal to the Cycle time. The consequent Hounsfield unit progress is displayed on the same graph that the threshold level is displayed on.

How Bolus Pro Ultra Works

The basic Bolus Pro Ultra operation consists of a set of three scans, **Locator**, **Tracker**, and **Clinical**, as shown below. These scans are preceded by a standard Surview scan and optionally followed by additional **Clinical** scans.

Bolus Pro Ultra - Sequence of Operations					
SURVIEW Scan	LOCATOR Scan	TRACKER Scan	CLINICAL Scan	Additional CLINICAL Scan(s)	
(Mandatory)	(Axial scan for positioning of patient and ROI, and for setting contrast level threshold)	(Axial scan for tracking uptake of contrast agent, then staring Clinical Scan)	(Helical scan for producing contrast-enhanced images)	(Optional - pre-planned at Surview)	

The **Locator** scan is performed before administration of the contrast agent. Its purpose is to allow setting the patient position, the ROI locations and the contrast enhancement threshold for the **Tracker** scan. The **Locator** and the **Tracker** scans are executed at the same position and therefore they appear as a single line on the Surview.

The **Locator** is a single fused scan series, which may be repeated by the operator for better patient positioning.

The **Tracker** scan is a fused axial scan series with fixed intervals between scans, determined by the Cycle Time. The **Tracker** and **Clinical** scan(s) are

performed after the administration of the contrast agent. The **Tracker** scan monitors the concentration of contrast agent at the specified ROI, and compares it to the set threshold. As soon as the threshold is exceeded, the **Tracker** scan is terminated, the patient table moves to the **Clinical** scan start location and the **Clinical** scan is performed automatically.

The **Tracker** scan may be terminated manually before the threshold is reached. Manual termination of the **Tracker** scan is followed by the same sequence of events (table movement and **Clinical** scan) that occurs after automatic threshold termination.

The first **Clinical** scan may be expanded by the addition of consecutive **Clinical** scans. Optional **Clinical** scans are pre-planned together with the first **Clinical** scan.

Planning Procedures for Bolus Pro Ultra

The Surview Scan

1. Begin planning the Bolus Pro acquisition by performing a standard planning Surview Scan. See **Chapter 3, Vol. 1 – Scanner Operation** for complete details on performing a Surview Scan.

Note

The Bolus Pro Ultra application cannot be used without a preliminary Surview scan on which the plan is performed.

Starting Bolus Pro Ultra

- **2.** Select the desired helix scan to be used for the BolusPro procedure and plan it. Be aware of the importance of the following parameters:
 - i. Start Position
 - ii. Length
 - iii. Slice Thickness
 - iv. Pitch
 - **v.** Rotation Time

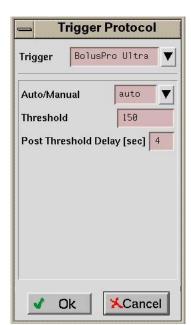
Since parameters (ii), (iii), (iv), and (v) have a direct impact on the Scan time, they also have a crucial importance for the contrast enhancement quality and for the overall contrast agent amount.

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The Start Position and Rotation Time parameters will be copied automatically as default for the **Locator** and **Tracker** scans.

The **Locator** and **Tracker** scans will take the Slice Thickness parameter for the generation of fused slices. The thickness will correspond to the collimation aperture (e.g. 4mm Slice Thickness if the **Clinical** scan Slice Thickness is Quad 1.3 mm and 2 mm Slice Thickness if the slice thickness is Dual 1.3 mm).

- 3. Open the Trigger window by clicking on **Trigger**. Click on the BolusPro Ultra mode within the Trigger ComboBox. A window is automatically opened upon selection of the BolusPro Ultra, as shown at right.
 - a. Change the threshold if necessary (according to the selection of the blood vessel, to the examined organ and to the patient).
 - **b.** Include a Post Threshold Delay (default is minimum) to pause the scanner after the trigger.
 - c. Click on OK if the parameter selection is completed or on Cancel to quit without changes.



Locator Planning

At this stage, the **Locator** scan protocol (shown at right) is automatically popped up as Sequence 2. It is by default a Fused mode scan, with collimation corresponding to the Slice thickness set for the Clinical scan at step 1. Some of the displayed parameters may be modified.

4. Position the Locator scan, if possible, at the start position of the **Clinical** scan. Otherwise, position it as close as possible to the start position. Set new values for the **Locator** scan parameters, if necessary. However, since most the parameters of the **Tracker** scan are taken from the **Locator** scan protocol, be aware that the new values may have repercussions on the procedure timing and on the image quality of the **Tracker** scanner.

The minimum necessary dose is preferred during the Locator and Tracker scans in order to reduce patient irradiation. A minimum dose is effective in this situation, since Locator scan images are not needed for diagnostic information and are not stored on the archiving media.



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Tracker Planning

5. Once all the parameters of the **Locator** scan are set, click on Next within the bottom of the Scan Protocol window to enable editing of the **Tracker** scan. It will appear as Sequence 3.

The Locator Scans and Tracker Scans are identical in their position and geometrical parameters. Therefore, the image screen shows a single position line (Seq. 2 and Seq. 3) for both scans. Movement of the Seq. 2 position line applies to both Locator and Tracker scans.

Scan length for the Locators Scans and Tracker Scans is fixed and limited to a single plane.

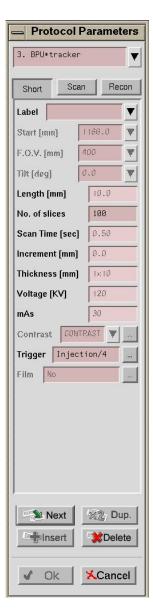
Sequence length is determined by slice thickness, and is identical for both Locator and Tracker scans.

6. The only independent Tracker scan parameter that can be changed at this stage is the number of scans. The main parameters are automatically copied from the Locator scan to the Tracker scan protocol.

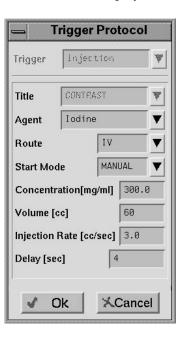
The user should be aware of the following facts:

- The overall available anode heat units attributed to the Tracker scan are a constant. Consequently, selecting a high number of scans will yield a relatively low value of maximum available mAs per scan.
- Selecting a low number of scans with low Cycle time may result in a situation where the threshold will not be reached during the tracking time

(tracking time = number of executed Tracker scans x the Cycle time).



- 7. To define whether the Tracker scan will start automatically or manually and to document the injection procedure, click on the Trigger window. Open the ComboBox to select the injector-triggered start of the scan or its manual start (by Operator). The Trigger Protocol window is displayed.
 - a. The **Title** ComboBox shows that the C label will appear on the images. The details of the injection can be inserted the Agent (iodine), the Route (IV/IP), the Concentration (to be typed), the Volume (to be typed) and the Injection Rate (to be typed).
 - b. The Delay defines the time lapse between the start of the injection and the start of the Tracker scan. The default Delay is the minimum available with the present scan parameters. When setting the delay, take into account that, during the first seconds of the injection, the contrast agent will not appear, and thus a suitable delay can eliminate unnecessary patient irradiation.



8. Click on OK to validate the Trigger protocol or on Cancel to quit without any change. A time ruler appears at the bottom of the screen showing the scan length and the start point relative to the injection start.

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Clinical Scan Planning

9. Once the parameters of the Tracker scan are set, click on Next at the bottom of the Scan Protocol box in order to enable re-editing of the Clinical scan. The time ruler now shows the lengths of both scans and their start times relative to the injection. The Scan is planned to start with a programmable delay after the threshold completion. This delay is called Post Threshold Delay (PTD). If the scan parameter selection does not fit the PTD, a warning appears and the PTD is automatically set to the minimum available value.

Once the **Tracker** scan is started, the parameters of the first **Clinical** scan cannot be changed. It is therefore essential to plan the **Clinical** scan carefully.

- **10.** If the whole procedure planning is ready, then skip to **step 14**.
- 11. If you wish to plan an additional Clinical scan then skip to step 13.
- 12. If you wish to re-edit the Locator or Tracker scan protocols then click on the respective scan protocol on the top of the Scan Protocol box. Return to step 4 for Locator editing instructions or to step 5 for Tracker editing instructions.
- 13. To edit an additional Clinical scan click on Insert/Dup and select an appropriate scan protocol, as described in Chapter 3, Vol. 1 Scanner Operation. Up to three additional scans can be programmed. To change the parameters, follow the same instructions as for the first Clinical scan editing.

Note that the PTD of the additional Clinical scan is by default the shortest available for a given situation. Like the PTD of the first Clinical scan, it is measured relative to the time that the threshold has been reached, at the end of the Tracker scan.

14. Click on OK to start the Bolus Pro.

Executing Bolus Pro Ultra After Planning

The order of the execution of the BolusPro scans is: Locator scan (eventually additional scans for better Tracker scan positioning), Tracker scan series, Clinical scan/s.



DO NOT ATTEMPT to manually change the gantry Tilt or the patient table UP/Down position during or between the Locator, Tracker, and Clinical scans.

Execution Sequence - Locator Scan

After confirmation of the BolusPro planning (see "Preparing BolusPro Ultra"), you are generally prompted to position the patient by continuously pressing on



Perform the scan. You will be prompted as follows:

- **a.** either to place an ROI on the blood vessel serving as reference for the contrast enhancement tracking and eventually to change the contrast threshold.
- **b.** or, to position and adjust the size of the ROI. If the slice position does not allow ROI positioning then repeat the scan for patient repositioning.
- **c.** or, to re-plan the entire procedure select the **Replan** key and use the surview to reposition the Locator plan.



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You may define up to four additional ROIs for recording purposes, but only the first ROI will be used to track contrast. **Press on the special ROI icon within the upper tool bar to insert a new ROI.** Each ROI will appear with its own color, corresponding to their respective plots on the graphs.

The image screen displays the graph axis with a line as default threshold HU value (factory preset to 150). Drag the solid line to reposition the threshold. A dotted line representing the measured averaged ROI value is displayed, parallel to that of the threshold.

The difference between the Threshold value and the average ROI value appears. Re-position the ROI if this difference is negative due to inclusion of high-density structures within the ROI (e.g. bones, calcifications, stents, etc.).

If the ROI position and the threshold value are confirmed by clicking on OK, the scanner will proceed to the next step.

Execution Sequence - Tracker and Clinical Scans

These two scans together should be considered as one sequence.

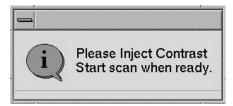
Before the **Tracker** scan starts, an active viewer opens. The left side of the Viewer is allocated to the Contrast enhancement vs. Time graph while the right side displays the images on which the contrast enhancement is measured.

The protocols of the **Clinical** scan(s) which will follow the **Tracker** scan can be partially edited at this stage.

The Auto Start mode: Once the injector icon is displayed, press on the Injector start button. The **Tracker** scan will start with the delay defined in the **Tracker** scan protocol after the injection start.



The Manual Start mode: Press the Manual button to start the Tracker scan and simultaneously on the Injector start button. The scan will start after a lapse of time equal to that defined as Delay in the Tracker scan protocol



Since the Delay will be counted down from the moment the Manual button is pressed, it is important to press both the Manual and the Injector buttons simultaneously.

As the Tracker scan begins, the images containing the ROI measurements appear at a rate equal to the previously defined cycle time. The computed averaged densities also appear on the graph, which is updated at the same rate.

The measured density within the ROI should reach the threshold value and then the Clinical scan should start.

Periodic checks of CT number correctness is essential for the accuracy of the Contrast vs. Time plot and consequently for the precision of the Clinical start timing.

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In case you wish to start the Clinical scan before the threshold is reached, press on **Start Clinical Scan** key.

The Clinical scan will start after a lapse of time equal to that defined in the Tracker scan protocol and after the table reached the pre-defined position.

A time ruler will display the countdown time to the end of the scan and to the start of the next Clinical scan, if any.



Watch the monitor screen during the Tracker scan. If an anomaly appears during the Tracker scan execution, for example:

- ♦ the graph does not appear
- the plot is not updated
- the images do not appear
- the contrast intake does not reach the threshold after a reasonable lapse of time

then proceed as follows:

- ▶ If visual examination of the CT images shows that the contrast intake is reasonable, then click on **Start Clinical Scan** and proceed guickly to the start of the Clinical scan.
- ▶ If the anomaly does not allow you to see if the contrast intake is reasonable, or if it is clear that the contrast intake is not sufficient, then immediately stop the scanning procedure (by either clicking on STOP/PAUSE or by pressing the STOP button on the Scan control panel) and then stop the injection.

Execution Sequence – Additional Clinical Scan

The additional **Clinical** scan(s) will normally start following the corresponding PTD (Post Threshold Delay) as defined during the plan. If you decide to start them before the scheduled time, click immediately on the Pause/Stop key after the completion of the first **Clinical** scan, and then on the Next Seq key. The scanner will enter the Ready status and the scan can be started by pressing on the Manual Scan key.

Hints

1. The PTD length is at least four seconds. If the **Scan start position** is different between the **Tracker** and the **Clinical** scans, then the PTD will be longer.

If bolus tracking can not be performed at the default location, minimize bed movement by setting a Tracker location as close as possible to the start position of the first **Clinical s**can.

- **2. Message** Another parameter impinging on the PTD value is the message. The **Clinical** scans will be preferably programmed without any message or with the shortest available messages. The patient will be preferably instructed by intercom close to the **Tracker** scan stop, when the ROI value almost reaches the threshold level.
- **3.** In order to optimize the contrast agent administration, the injection time for arterial phase examinations should be roughly equal to the **Clinical** Scan time.

It is known that a high injection rate results in good contrast enhancement. High injection rates (if the physician assesses that the patient can afford this) are affordable mainly for short injection time.

Alternatively, a short Scan time may allow moderate injection rate with acceptable contrast level and relatively low Contrast agent administration.

Thus, for arterial examinations, the Scan time should be as short as possible.

- **4.** In the case of a first-phase Aortic scan, it is recommended to set the Threshold Level at 90 to 100 HU in order to enable the system to start the first **Clinical** Scan at the optimal contrast level.
- **5.** In typical cases with abdominal aortic tracking of the attenuation level of an intravenous contrasting agent injection, set the **Tracking** Scan to begin

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6. Locator Default Parameters - In order to avoid miscalculation of contrast agent attenuation within the ROI, the software restricts the use of certain parameters to default values as follows:

Reconstruction mode (On Line)

Scan Increment (0)

Fused mode

Image Matrix (256²)

Resolution (STD or Ultra Fast)

Number of slices (1)

Locator and Tracker slice width 1 mm is eliminated.

7. Tracker Parameters - The following parameters are set by the software to be identical with their Locator values:

Scan diameter

Slice thickness

Filter

Center X,Y

Field of View

Tilt

Location

kVp

mAs

8. Fixed Parameters - The following parameters are predefined, and can not be changed:

Matrix (256²)

Reconstruction Filter B

Fused

8

9. Only the last image of the **Tracker Scan** is saved on the local disk. This image contains the following information:

Active ROI's **Hounsfield Unit** (HU) level

The elapsed time from injection.

10. The Injector display panel is supposed to provide the Bolus administration data. This is the ultimate device for observing Injection time, proper bolus flow, flow rate etc.

Pay particular attention to the Injector display during the bolus administration. Use the display information as the basis for your procedure control decisions.

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9

Continuous CT (Option)

General

Continuous CT (CCT) is a scanning mode that allows the physician to perform extended, low-dose scans while performing a biopsy. By depressing a footpedal switch in the gantry room, the clinician controls the X-ray control of the scanning. The resulting images are displayed on a monitor in the scan room, providing near-real-time visual feedback during the biopsy.

To accommodate siting variations, the display monitor may be attached to a cart (**CART option**) or it may be mounted on a ceiling arm (**Ceiling-Mount option**).

Principles of Operation

This function requires 2 persons for best performance: a technologist seated in the operator-room and an interventional doctor who conducts the biopsy procedure in the scanner-room. To shorten the biopsy procedure, the doctor activates the foot-pedal during the biopsy procedure.

The biopsy procedure starts by positioning the patient on the table (prone or supine) according to the planned area of the biopsy. In general a surview and a pilot sequence of scans (axial or spiral) are performed to help locating the lesion (the target) and planning the insertion path (trajectory) of the needle. A typical slice is then selected, and by using the graphics tool-box (distance and angle measurements) the biopsy planning can be easily performed.

The insertion point is usually marked on the patient skin and the biopsy is actually initiated. The biopsy-needle is inserted and its location can be monitored at almost real-time on the monitor. The interventional doctor activates the pedal and a burst of scans (Continuous mode) or a single image scan (Single mode) are executed with low-dose axial scanning. As the pedal is released the scans and the radiation stop at once.

During scans, the images are displayed on the remote monitor in the fastest possible cycle-time according to the format (1, 2 or 4 images) prior selected in the protocol.

The doctor has to follow the needle-tip as he/she proceeds with the insertion toward the target.

For better real-time viewing, the displayed images are shown as from the 'Table View' orientation position. This view may conflict with the normal default images orientation (View from Feet) as set in the default setting of the scanner.

When displaying more than one image per frame (2 or 4 images), the images will be displayed simultaneously every scan and each image will represent a different slice location. The needle can be then in more than one slice location and, by identifying the needle-tip, the next table translation can be planned.

Table and gantry movements are supported during the CCT procedure to reposition the patient for the next scan session. The following movements are permitted while x-rays are off: table in/out and up/down, and gantry tilt plus and minus.

As the pedal is released at the end of the burst-session, the last needle position remains 'frozen' on the screen. These images are also registered in the normal study-viewer and can be used for archiving and filming. The last image also can be windowed, panned and zoomed, and those settings will be kept for the next scan-burst.

The CCT operation can be halted or stopped at the end of the procedure by the technologist.

CCT Components

The components required to use the Continuous CT application are as follows:

- A **Foot- switch,** used by the physician to activate the CCT scan from within the scan-room..
- CCT System with monitor on a cart.
 - -- Or --
- CCT System with monitor on a ceiling arm.

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Special Safety Instructions for CCT Accessories

Foot Pedal

The foot pedals must be kept free of foreign objects to ensure easy and safe access for their operation. Be *careful* not to step on the pedal housing. Care must be taken not to collide with the pedal housing.

Additional Monitor Cart (opt.)

The additional monitor cart inside the scanner room should not be used to hold anything but the original monitor. The 21-inch monitor-base should always be on top of the stand and secured properly. When not in use, the cart and its cables should be moved to a corner of the room so they do not interfere with routine activities in the scanner room. Care must be taken not to collide with the monitor stand or trip on the monitor cables.

Additional Monitor Ceiling support (opt.)

The Additional Monitor ceiling support is a heavy device, which is attached to the gantry-room ceiling and mainly carries the 20" flat monitor. Do not hang any other items on this support such as aprons and other accessories.

When not being used, the Additional Monitor support should be folded and out of the way of the examined patients and the technologists on site.

Hand-Protection Accessories (not supplied)

When operating the system in the Continuous CT scanning mode, **Needle-holding handles** should be used to avoid direct irradiation to the doctor's hands.

Also, **Radiation-reducing** gloves are recommended for this procedure, if Needle-holding handles are not used.

Preparations for Biopsy

The following preliminary preparations must be done before beginning the procedure.

- **1.** Position the monitor in the gantry room at a convenient location, taking into account the expected direction of approach to the patient.
- **2.** Check that the foot pedal is free from interfering objects and is easily accessible to the Interventional operator.
- **3.** Make sure that the Gantry Indication Lights (green, yellow and buzzer) are functioning properly by performing a CT Scope scan without a patient.
- **4.** Prepare sterile materials, if necessary. For example, a clear sterile sheet with an adhesive strip may be attached over the Gantry panel for operating the table motions from the Gantry room.
- **5.** Check the intercom for clear bi-directional communication between the Interventionist and the console operator.
- **6.** Prepare the appropriate radiation shielding equipment and materials.
- **7.** Prepare the intervention kit, including the extended handle and accessories.

If the monitor is located on a cart, make sure that the cables connected to the device are not on the way of the patient or the personnel in the scan room.

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CCT Scan Parameters

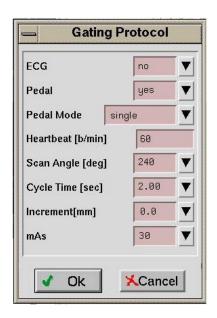
Gating Protocol

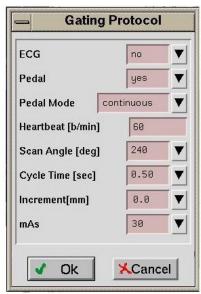
In order to activate CCT mode, the foot pedal has to be declared in the "Gating Protocol" dialog-box as **Pedal**; yes.

This gating parameter sets the table increment to zero; the mAs setting is forced to less than 150 mAs.

There are two activation modes for the pedal: **Single** and **Continuous**, selected in the **Pedal Mode** field.

- **Single** mode activates a scan each pedal depression.
- **Continuous** mode will force burst scans in the fastest cycle time (240 degrees, 0.5 cycle time, and 2 images per second).





Q

The ECG and Heartbeat settings should not be changed when performing a CCT scan.

Thickness

The thickness parameter plays an important role in CCT. The selected thickness determines both the tomographic thickness of the CCT images and the layout screen of the CCT Viewer.

The tomographic thickness is selected according to the standard needle diameters used in biopsy and FNA procedures.

CCT Tomographic Thickness			
	Image Screen Layout		
	Single	Dual	Quad
Dual Slice System	1 x 5 F 1 x 10 F 1 x 20 F	2 x 5 2 x 8 2 x 10	
Quad Slice System	1 x 4 F 1 x 10 F 1 x 20 F	2 x 5 F 2 x 10 F	4 x 5

In **Single Pedal** mode, any of these combinations are allowed to be selected. In **Continuous Pedal** activation mode, only **fused (F)** images are permitted and only a **single image layout** is available. Images are reconstructed in a dedicated 256x256 matrix and displayed in the fastest cycle time of 2 images per second.

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CCT Reconstruction Parameters



Following are the special parameters that are typical to CCT reconstruction:

- **on line** full or partial quality reconstruction after each scan, before the next scan is enabled.
- Matrix 340²,512² and also special 256² matrices are available for CCT reconstruction. Matrix 256² is especially designed for real-time reconstruction of the single layout display and is forced into Continuous Pedal activation. (The 256² option is not available for Single mode.)
- **Film** Only the last set of images per scan session is available for filming.
- Image storage Only the last set of images per scan session can be stored. Those images are temporary kept in the Study-Viewer.

To view all images not saved in the Viewer, the study must be reconstructed after the completion of the exam.

O

Starting the Biopsy Procedure

After you have made the Biopsy protocol selection, control of scanning is passed to the foot pedal. When the scanner is ready, the following message appears in the bottom of the CCT screen.



The accumulated session time is shown, indicating the time of irradiation (in seconds) during the current biopsy session. Total dose to patient is calculated by the following formula:

(Total Number of Images) x (CTDI Value per Slice) = Total Dose

Depending on the mode of Pedal Activation, with the pedal already set in the protocol, either single X-ray shots or a continuous burst of scans are generated.

- Switching between the Single and Continuous modes is possible by Pausing the session and resetting the Pedal Mode parameter in the biopsy protocol monitor.
- The table can be moved in/out between successive pedal activations for more convenient patient handling, or for adjusting the patient scanning area for better lesion localization.

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Lesion Localization Process

The different screen layout offers an easy process for the lesion localization.



In the 4 images format (only in Quad scanners), the 4 adjacent slices are displayed. The upper-left image represents the slice closest to the doctor standing near the table in front of the gantry (slice I) and the lower-right image represents the slice farthest from the doctor (slice IV). **The laser marker is located exactly between slice II and Slice III.**

In the Dual display, 2 images are shown; for a Quad scanner they represent the partial fused images; for a Dual scanner they are the normal display. **The laser marker is located exactly between slice I and Slice II.**

In the Continuous mode a single format is chosen. The displayed image is a Fused image. The laser marker is located exactly in the Table location of the Fused image.



Regardless of screen format, images are displayed in the special **view 'from bed'** to help the radiologist with the patient orientation.



Warning!

If the needle tip is not visible in any of the displayed images, it implies that the needle tip is not present in the beam path indicated by the slice thickness in the corresponding table location. The table location must be changed so the needle tip is clearly visible in an appropriate slice.

9 - 10 Nov 2001

Radiation Information

The CCT mode is intentionally designed to activate the X-Rays and CT scanning while a member of the medical staff is present in the gantry room.

Scanning is initiated by depressing a foot pedal, which energizes the X-Ray generator. In general, the gantry room is equipped with warning lights and a buzzer to give an alarm when X-Rays are on. The shielding of the scanner room does not provide any protection to the medical staff present in the gantry room; the staff should be aware of the hazard imposed by direct and scattered radiation.

During CCT mode the technologist and other personnel should be aware that control of the activation of X-Rays originates in the gantry room and not from the main console.

The dose to the patient is displayed to the technologist upon selecting the protocol. If the table increment is 0, the number of the repeated scans multiplies the dose to the patient.



Warning!

If there is any indication that X-rays are not turned off after releasing the foot pedal switch, press one of the **STOP** buttons located on either side of the front of the gantry. This will stop the generation of X-rays, scanner rotation, and patient table motion. (To recover from the STOP condition, refer to "Emergency Procedures," early in chapter 3 of this manual.)

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Scattered Radiation information

In the CCT mode, scans with a rotation angle of 240⁰ are used, which are centered beneath the patient. As a result, the scattered dose above the patient is only about one third of the dose beneath the patient and at his or her sides.

At 0.5 m from the slice plane, the dose/slice over the patient is 0.6 mGy/scan. Below the patient and at the sides the dose/slice is 2 mGy/scan.

Accumulated dose at 0.5 m distance = (Accumulated session time) x 1.8 mGy

The scan conditions are:

- 120 kV, 50 mAs
- Fused 4 mm slice thickness
- 240⁰ scan angle
- 0.33 sec scan time

For a slice thickness of 4x5 mm the doses are 5 times greater.

The radiation dose changes linearly with the mAs and Slice Thickness.

The dose at **140 kV** is 1.4 times higher than at 120 kV.

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Using Windows

Working Environment

The operation of the workstation is based on a Windows-like, mouse-driven graphical environment. Selections are made from icons, buttons, tool bars, menus, dialog boxes and control panels by pointing and clicking with the mouse.

Manipulations and operations on the workstation are generally performed in the following order:

- 1. Selection of the images or other objects to be manipulated.
- **2.** Selection of the operation to be performed.
- **3.** Interactive manipulation.

Mouse

The mouse is a device that controls a graphical **pointer** used to select objects on the screen. As the mouse is moved, the pointer follows in the same direction allowing you to navigate through windows, menus and images.

Throughout this guide the terms "mouse" and "pointer" (referring to the mouse pointer) are used synonymously.

If the mouse comes to the edge of the mouse pad before the pointer reaches the desired position, do as follows:

- **1.** Pick up the mouse and place it in a more convenient position on the mouse pad.
- **2.** Continue to move the mouse until the pointer reaches the desired position.

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There are **three** buttons on the mouse:

- 1. The **left button** is used to perform most tasks. It is used to select images, activate functions, select items from menus, run applications, and manipulate windows (move, resize, overlay one on the other, and so forth).
- **2.** The **middle button** is used for changing the *windowing* CENTER and WIDTH.
- **3.** The **right button** is used for opening a secondary pop-up window. If the mouse is pointing to a certain object or image, clicking the right button opens a pop-up menu which includes the most frequently used operations for that object or image.

Following are a few examples of using the right button:

- Right-clicking over the Line and ROI icons in the Graphics Tool Box: provides additional shapes.
- Right-clicking over the windowing sliders: presents a list of preset windows.
- Right-clicking over the image area: presents operations which can be made on images.
- Right-clicking over the color palette in the 3D view parameters dialog box: provides additional colors.

There are three ways of using the mouse buttons:

- 1. Click, that is, momentarily press and release the button.
- **2. Double-Click**, that is, click the button twice in rapid succession.
- **3. Drag**, that is, press the button and hold it down while moving the mouse; used for performing continuous operations like zoom, rotate and *windowing*.

Zoom, for example, is performed by dragging the mouse with the left button pressed: up for magnifying the image and down for reducing it.

Windowing CENTER is changed by dragging the mouse up and down with the middle button pressed, WIDTH is changed by dragging left and right, also with the middle button pressed.

A - 2 Nov 2001

Icons

Icons are miniature pictures that represent programs, processes, commands, functions and devices.

To **activate** an item represented by the icon, click on the icon. If the icon represents a minimized window, double-click to enlarge it.

Basic Use of Windows

The user can open several applications simultaneously. Different applications can run simultaneously in different windows. Each window that is opened appears on top of the previous window. To bring to the foreground a window that is partially covered by another window, bring the pointer anywhere within that window and click the left mouse button.

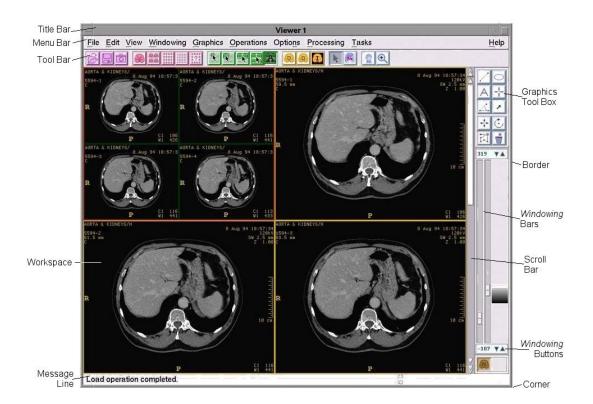
If the desired application window is not visible, select it from the Tasks menu in any window. Alternatively, press **<Alt>** + **<Tab>** repeatedly until the window or icon is displayed.

Window Structure

The window consists of:

- Title Bar
- Menu Bar
- Tool Bar
- Workspace
- Tool Box
- Scroll Bar
- Message Line
- Borders
- Corners

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The **Title Bar** displays the name of the application currently being used. It also may be used for moving the window (see "Moving a Window" below).

To the extreme left of the **Title Bar** there is a Control Button on it opens up a pop-up menu which may be used for **moving**, **resizing** and **closing** the window. Double-clicking this button closes the window and exits the application.

The **Menu Bar** contains the various menus used to activate functions. All the available functions may be selected from menus.

The **Tool Bar** contains the icons of the most frequently used functions. For example, to save an image file you can either click on the Save icon or, you can choose **Save Image** from the **File** Menu.

A - 4 Nov 2001

The Workspace is the large window area where images are displayed.

The **Graphics Tool Box** is located on the right side of the window. It mainly contains buttons for functions that aid analysis of image features by marking and measuring features on the image. It may also contain accessories for *windowing* and tissue definition.

The **Scroll Bars** along the edges of the Workspace are used to leaf through the displayed images.

The **Message Line**, at the bottom of the screen, displays the operations in progress, their status and short help messages.

To get a description of an icon, place the pointer on the icon and wait a few seconds - an information message appears describing the function of the icon (this is in addition to a pop-up window that appears by the icon).

The **Borders** enclose the window and may be used for resizing the window by dragging them in a perpendicular direction

The **Corners** of the window border may be dragged in any direction for resizing the window.

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Window Operations

When working with programs and applications, a number of windows may be opened. The user can:

- Move any Window
- Size any Window
- Maximize/Restore any Window
- Minimize any Window to an Icon, and Restore any Window from an Icon
- Close any Window

In addition to the procedures outlined below, most window manipulations may also be performed from the Control Button



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Moving a Window

To move a window to another location:

- **1.** Bring the pointer to the Window Title Bar and press the left mouse button.
- **2.** Keeping the mouse button pressed, drag the window to the new location.
- **3.** Release the mouse button.

Sizing a Window

To **change the size** of a window:

- **1.** Bring the pointer to the border or corner of the window. The pointer changes to an arrow or corner shape.
- **2.** Press the left mouse button and drag the corner or border until the window is of the required size.

Maximizing/Restoring a Window

To **maximize** a window to its maximum size, click the Maximize button in the upper-right corner of the window. The button appears pressed.

To **restore** an enlarged window to its previous size, click again on the button in the upper-right corner of the window. The Window reverts to its previous size and the button appears *not* pressed.



Minimizing a Window to an Icon

To **minimize** a window to an Icon, click the Minimize button which is the second button from the extreme upper-right corner of the window. The window is reduced to an icon, usually at the bottom of the screen.

To **restore** an icon to a window, double-click the icon.

Closing a Window

To **close** a window:

- 1. Double-click the Control Button at the upper-left corner of the window, or
- 2. From the <u>File</u> menu, choose **Exit**, or From the Control Button menu, choose **Close**, or Press <**Alt>** + <**F4>**.

Use of Scroll Bar

- **1.** To scroll continuously through images displayed in the window, drag the slider within the Scroll Bar.
- **2.** To scroll one image up or down, click the up or down scroll arrow.
- **3.** To scroll one line of images up or down, click the **double** scroll arrow (available in some applications).
- **4.** To scroll one full screen with images, click the scroll bar above or below the slider.
- **5.** To scroll to any position, drag the slider in the scroll bar to the position you desire.

A - 8 Nov 2001

Window Menus

Each window has a Menu Bar which contains all the available functions and operations pertaining to the particular application.

Menu Selection

To **select a menu**, click on the menu name with the left mouse button. A pull-down menu appears with the various options. It remains open until you click the desired option. Alternatively, press the left mouse button and drag to the desired option. Releasing the button on an option activates it.

Menus may also be activated by pressing **<Alt>** and the underlined character of the menu name. An item from the menu may be selected by pressing the key corresponding to the underlined letter of the item's name.

Accelerator keys appear next to some options. They denote that fast activation of the operation may be performed from the keyboard without moving the mouse from the object to be manipulated.

If a command appears **dimmed**, it means that the operation cannot be currently used.

If an ellipsis (...) appears after a command, it means that a dialog box will appear if this command is chosen.

If a pears to the right of the command, it means that a sub-menu will appear if this command is chosen.

If a n appears to the left of the command, it means that the command is currently in effect. Re-selecting the command has the effect of canceling the command.

To **close a menu**, click the menu name or click anywhere outside the menu.

A

Dialog Boxes

The Dialog Box is used to obtain additional information. The system automatically displays a Dialog Box when certain functions require more information.

If a Menu option is followed by three dots, then selecting it always brings up a Dialog Box.

- 1. Some Dialog Boxes contain options with a square or diamond-shaped Check Box located next to them. To select an option, click on the box; the box turns gray or yellow.
 - If the Check Box is square-shaped, its selection is added to the other Check Boxes in the Dialog Box. To unselect an option, click on the box again; the box is cleared.
 - If a Diamond-shaped Check Box is selected, it unselects any other diamond-shaped Check Box in the column or row of the same group; one and only one diamond Check Box is selected (yellow-filled) at a time. A diamond-shaped Check Box is unselected by selecting another Check Box in the same group of buttons.
- 2. Some Dialog Boxes contain text or numeric fields. To fill a text or numeric value field, click on the field and type in the information. To the right of most numeric fields is located a pair of up-down arrows. Click on the up arrow to increment the value in the field and down to decrement it.
 - To **move within a field** of the Dialog Box, use the mouse or arrow keys.
- **3.** Some Dialog Boxes present a list of selections.
- **4.** To **confirm** and **close** a Dialog Box, click the **OK** button.
- **5.** To **cancel the changes and exit**, click the **CANCEL** button or press **<Esc>** on the keyboard.

A - 10 Nov 2001

Getting Help

If you leave the mouse pointer on any button of the Tool Bar or Tool Box for more than three seconds without clicking, a small popup window appears with a reminder of the button's function.

On-line Manual

The On-Line manual can be accessed from any application as follows:

- 1. From the Help menu, select Operation Manual.
- **2.** The On-Line manual is loaded into Netscape. The Table of Contents is displayed in the Left Frame. It is a dynamic Table of Contents.
- **3.** Clicking on the \downarrow icon, hides the nested topics.
- **4.** Clicking on the \rightarrow icon, displays the nested topics.
- **5.** Clicking on a topic name displays its contents in the Right Frame.

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Image Performance Quality Assurance

General

Imaging performance of the scanner is checked by scanning head and body system phantoms.

When testing image quality, the system should be properly calibrated.

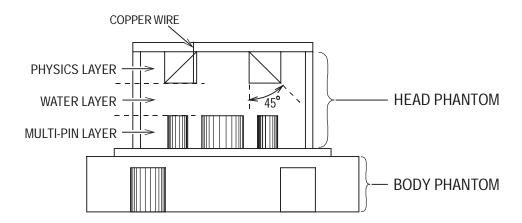
Head and Body System Performance Phantom

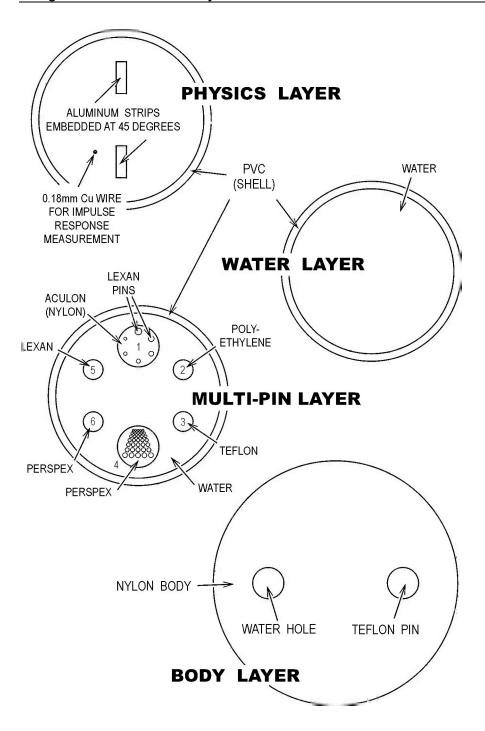
The **Head Phantom**, is a 200 mm diameter PVC shell filled with water. The Head Phantom has three sections (detailed drawing on next page):

- **1.** The physics layer is used for impulse response and tomographic section thickness (slice width) measurements.
- **2.** The water layer is used for measuring noise.
- **3.** The multi-pin layer is used for contrast scale check.

The **Body Phantom** is a 300 mm diameter nylon cylinder (absorption 100 ± 10 CT), including a Teflon pin (absorption 890 ± 50 CT) and a water hole (0 ± 10 CT).

В





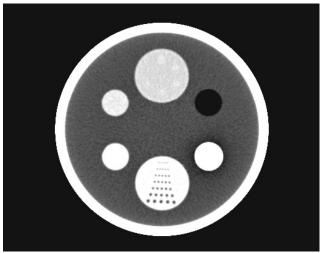
B - 2 Nov 2001

Composition - Multi-Pin Layer

Pin Number	Description	
1	Nylon (Aculon) body with six smaller Lexan pins of 3 mm, 4 mm, 5 mm, 6 mm, 7 mm and 8 mm diameter.	
2	Polyethylene	
3	Teflon	
4	Perspex with seven rows of holes of different diameters. Each row has five equidistant holes of the same diameter, as follows: Row 1	
5	Lexan	
6	Perspex	
Region 7	PVC (shell)	

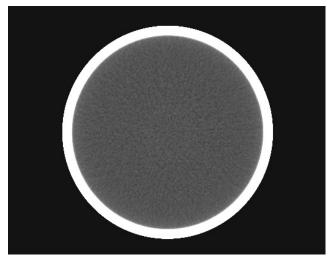
 \mathbf{B}

Representative Quality Assurance Images

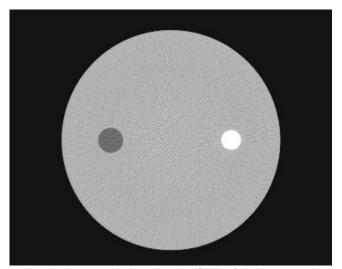


Multi-Pin Layer Using Head STD-QA Protocol

B - 4 Nov 2001

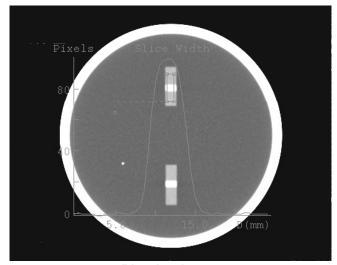


Water Layer Using Head STD-QA Protocol

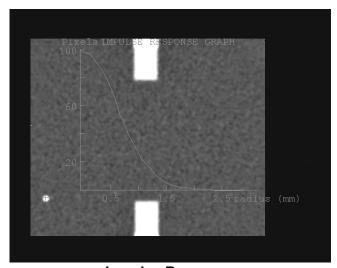


Body Layer Using Body STD-QA Protocol

R



Physics Layer
5mm Slice Width Using Head STD-QA Protocol



Impulse Response
Using Modified (100 F.O.V.) Head STD-QA Protocol

B - 6 Nov 2001

Schedule of Quality Assurance Checks

Daily Checks

- 1. Noise on head phantom, water layer
- 2. Contrast scale and artifacts on head phantom, multi-pin layer
- 3. Noise and artifacts on body phantom

Monthly Checks

- 1. Impulse Response on head phantom, physics layer
- **2. Slice thickness** on head phantom, physics layer for all slice thicknesses

→ Note

Mx8000 Quad and **Mx8000 Dual** - Procedures for performing the Quality Assurance Checks for the Mx8000 Quad and the Mx8000 Dual are given in separate sections in the balance of this appendix.

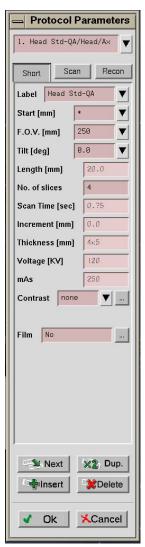
Mx8000 Quad

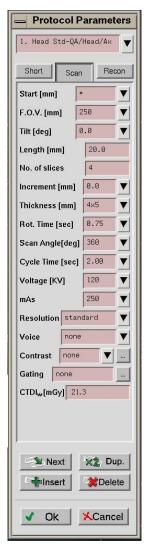
Daily Checks - Mx8000 Quad

Head Scans

- **1.** Position the multi-pin layer of the Head Phantom in the center of the scan circle
- **2.** Perform a scan using the Head STD-QA protocol with parameter values as shown below.

Short Scan Recon







B - 8 Nov 2001

Check the quality of the images according to the following criteria:

- All images must be free of artifacts.
- The following features must be clearly resolved: All Lexan pins in the nylon (Aculon) pin, all holes inside the large Perspex pin.
- The readings for the absorption of the different pins must be as follows (values in CT numbers):

Water : 0 ± 4

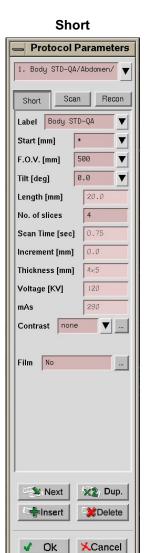
Nylon (Aculon) : $+100 \pm 10$ (+10% relative to water) Polyethylene : -80 ± 10 (-8% relative to water) Teflon : $+990 \pm 50$ (+99% relative to water) Perspex : $+140 \pm 10$ (+14% relative to water) Lexan : $+120 \pm 10$ (+12% relative to water)

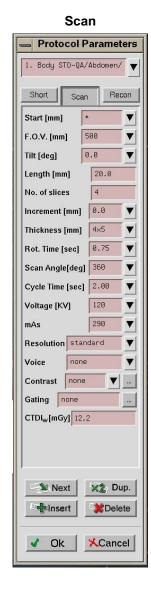
→ Notes

- All measurements should be made by positioning a small ROI well within each of the checked pins and regions.
- Due to differences in materials used, the actual absorption values may differ from the above. In such cases, use the values marked on the phantom label.
- B
- **1. Water Layer** Perform an additional scan with the Head STD-QA protocol of step **2** on the water (middle) layer of the Head Phantom.
- 2. For all images, place an ROI with an area of 7000 ± 2000 mm² around the center of the phantom image.
- 3. Check that the AV (average) is 0 ± 4 CT and the SD (Standard Deviation) is 4.2 ± 0.7 CT.
- 4. If the SD is not displayed, change the setting in **Options**; **Display** Utilities; **ROI** Values.
- 5. Check with the LINE that the diameter of the large Perspex pin is 50 ± 1 mm.

Body Scans

- 1. Position the body phantom in the center of the scan circle.
- **2.** Perform a scan using the Body STD-QA protocol (under "Abdomen") with the parameter values as shown below.







B - 10 Nov 2001

- **3.** Check the image quality according to the following criteria:
 - All images must be free of artifacts.
 - The absorption reading of the phantom should be 100 ± 10 (or the CT number on the phantom label ± 10 CT) and that of the Teflon pin 890 ± 50 CT.

- All measurements should be made by positioning a small ROI well within each of the checked pins and regions.
- Due to differences in materials used, the actual absorption values may differ from the above. In such cases, use the values marked on the phantom label.
 - **4.** For all images, place an ROI with an area of $14000 \pm 1000 \text{ mm}^2$ around the center of the phantom. The ROI should not touch the Teflon pin or water hole.
 - **5.** Check that the AV is 100 ± 10 CT (or the CT value on the phantom label) and SD is 10.5 ± 1 CT.
 - **6.** If the SD is not displayed, change the setting in **Options**; **Display Utilities**; **ROI Values**.

В

Monthly Checks

Impulse Response Measurements

- **1.** Position the physics layer of the head phantom in the center of the scan circle.
- **2.** Perform a scan using the Head STD-QA protocol, with the parameter values listed in the Daily Checks section, except F.O.V. (mm) = 100.
- 3. Activate the MISC, Impulse Response.
- **4.** The Full Width at Half Max of the Impulse Response profile should be $1.45 \text{ mm} \pm 0.10 \text{ mm}$.

Tomographic Section Thickness (Slice Width) Measurements

- **5.** Position the physics layer of the head phantom in the center of the scan circle.
- **6.** Perform a scan using the Head STD-QA protocol, with the parameter values listed in the Daily Checks section (with F.O.V. [mm] = 250).
- **7.** Activate the **MISC**, **Slice Width** program, and bring up the image of the physics layer.
- **8.** Place the ROI across the image of the aluminum (Al) strip and note down the slice width that the program calculates.
- **9.** Measure the slice width of the image of the other Al strip. The mean of the two measurements should be 5.0 ± 0.5 mm (FWHM).
- **10.** Repeat steps **1** through **3** performing scans on 2.5 mm, 1.0 mm and 0.5 mm slice widths. All three scans should be performed in the Ultra High Resolution mode and reconstructed with filter E. The measured slice widths should be:
 - 2.5 ± 0.5 mm, 1.0 ± 0.5 mm and 0.5 ± 0.5 mm.

Note

The 0.5 mm result appears wider due to the limited resolution of the image and the thickness of the measuring ramp.

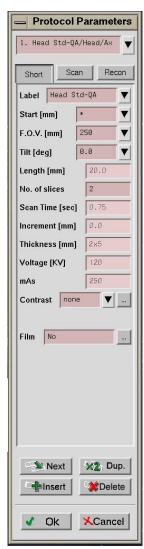
B - 12 Nov 2001

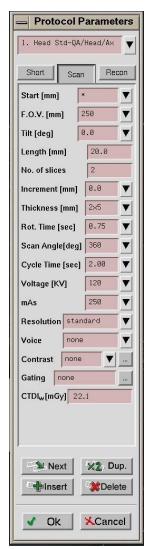
Daily Checks - Mx8000 Dual

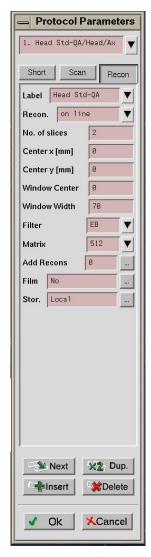
Head Scans

- 1. Position the multi-pin layer of the Head Phantom in the center of the scan circle
- **2.** Perform a scan using the Head STD-QA protocol with parameter values as shown below.

Short Scan Recon







B

Image Performance Quality Assurance

Mx8000 Dual

Check the quality of the images according to the following criteria:

- All images must be free of artifacts.
- The following features must be clearly resolved:
 All Lexan pins in the nylon (Aculon) pin, all holes inside the large Perspex pin.
- The readings for the absorption of the different pins must be as follows (values in CT numbers):

Water : 0 ± 4

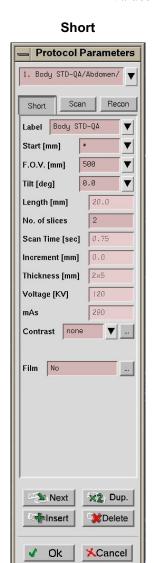
Nylon (Aculon) : $+100 \pm 10$ (+10% relative to water) Polyethylene : -80 ± 10 (-8% relative to water) Teflon : $+990 \pm 50$ (+99% relative to water) Perspex : $+140 \pm 10$ (+14% relative to water) Lexan : $+120 \pm 10$ (+12% relative to water)

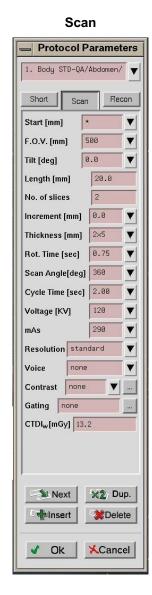
- All measurements should be made by positioning a small ROI well within each of the checked pins and regions.
- Due to differences in materials used, the actual absorption values may differ from the above. In such cases, use the values marked on the phantom label.
- **3. Water Layer** Perform an additional scan with the Head STD-QA protocol of step **2** on the water (middle) layer of the Head Phantom.
- **4.** For all images, place an ROI with an area of $7000 \pm 2000 \text{ mm}^2$ around the center of the phantom image.
- 5. Check that the AV (average) is 0 ± 4 CT and the SD (Standard Deviation) is 4.2 ± 0.7 CT.
- 6. If the SD is not displayed, change the setting in **Options**; **Display Utilities**; **ROI Values**.
- 7. Check with the LINE that the diameter of the large Perspex pin is 50 ± 1 mm.

B - 14 Nov 2001

Body Scans

- 1. Position the body phantom in the center of the scan circle.
- **2.** Perform a scan using the Body-STD QA protocol with the parameter values as shown below.







B

Image Performance Quality Assurance

Mx8000 Dual

- **3.** Check the image quality according to the following criteria:
 - All images must be free of artifacts.
 - The absorption reading of the phantom should be 100 ± 10 (or the CT number on the phantom label ± 10 CT) and that of the Teflon pin 890 ± 50 CT.

- All measurements should be made by positioning a small ROI well within each of the checked pins and regions.
- Due to differences in materials used, the actual absorption values may differ from the above. In such cases, use the values marked on the phantom label.
 - **4.** For all images, place an ROI with an area of $14000 \pm 1000 \text{ mm}^2$ around the center of the phantom. The ROI should not touch the Teflon pin or water hole.
 - **5.** Check that the AV is 100 ± 10 CT (or the CT value on the phantom label) and SD is 10.5 ± 1 CT.
 - **6.** If the SD is not displayed, change the setting in **Options**; **Display Utilities**; **ROI Values**.

B - 16 Nov 2001

Monthly Checks

Impulse Response Measurements

- 1. Position the physics layer of the head phantom in the center of the scan circle.
- **2.** Perform a scan using the Head STD-QA protocol, with the parameter values listed in the Daily Checks section, except F.O.V. (mm) = 100.
- 3. Activate the MISC, Impulse Response.
- **4.** The Full Width at Half Max of the Impulse Response profile should be $1.45 \text{ mm} \pm 0.10 \text{ mm}$.

Tomographic Section Thickness (Slice Width) Measurements

- **5.** Position the physics layer of the head phantom in the center of the scan circle.
- **6.** Perform a scan using the Head STD-QA protocol, with the parameter values listed in the Daily Checks section (with F.O.V. (mm) = 250).
- **7.** Activate the **MISC**, **Slice Width** program, and bring up the image of the physics layer.
- **8.** Place the ROI across the image of the aluminum (Al) strip and note down the slice width that the program calculates.
- **9.** Measure the slice width of the image of the other Al strip. The mean of the two measurements should be 5.0 ± 0.5 mm (FWHM).
- **10.** Repeat steps **1** through **3** performing scans on 2.5 mm, 1.0 mm and 0.5 mm slice widths. All three scans should be performed in the Ultra High Resolution mode and reconstructed with filter E. The measured slice widths should be:
 - 2.5 ± 0.5 mm, 1.0 ± 0.5 mm and 0.5 ± 0.5 mm.

The 0.5 mm result appears wider due to the limited resolution of the image and the thickness of the measuring ramp.

В

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User Information

Technique Factors—Maximum Deviations

X-Ray Tube Voltage

The X-ray voltage is displayed on the Operator Workstation Screen. The actual X-ray voltage during scan is within $\pm 5\%$ of the displayed value, which is in the range of 90 to 140 kV.

The X-ray voltage is measured on a resistive divider which is calibrated during the manufacturing process.

X-Ray Tube Current—Exposure Time Product

The actual current exposure time product (in mAs) during a scan is within $\pm 30\%$ of the value displayed on the Operator Workstation screen. The tube current exposure time product is measured by a dosimeter calibrated in mAs. The dosimeter is calibrated by measuring the tube anode current on an accurate resistor between X-ray ON and OFF during a long exposure.

Gantry Laser Alignment Lights

The Mx8000 Gantry has two sets of laser alignment lights. One set is on the outside surface of the gantry, and the other on the inside, on the scan plane.

The outside laser lights are useful for positioning the patient with respect to the axis of rotation. The inside laser alignment light is useful for defining the position of the actual X-ray beam.

The alignment light that is inside the gantry bisects the width of the proposed X-ray beam scan plane during patient set-up. It actually locates the position of the middle of the first slice of subsequent axial and helical scans. On the Quad, the patient couch moves 1-1/2 slice widths during scan initialization; on the Dual, the patient couch moves 1/2 slice width during scan initialization – in both systems the couch aligns the middle of the first slice with the laser line.

C

Preventive Maintenance

- 1. Routine preventive maintenance for the whole CT system is scheduled every six months and should be performed by qualified Philips personnel.
- **2.** Every six months, check the Anode, and Cathode voltages, the emission current and exposure time using the diagnostic program.

X-Ray System Specifications

X-ray Tube

- **1. Leakage:** Leakage of the tube housing assembly together with the beam limiting device is less than 80 mR/hr @1 meter.
- **2. Filtration**: Minimum tube housing filtration is 0.6 mm titanium. The beam limiting device includes an additional 0.6 mm titanium filter.
- **3. Rating Chart:** Refer to figure C-1c, Tube Power Rating Chart.
- **4. Cooling Curves**: Refer to Figure C-1a, Anode Cooling and Heating Curves.

X-Ray Power Supply

- 1. Line Voltage and Regulation: Power supply input voltage is 380 V to 480 VAC + 10% / -25%, 3 phase 50/60 Hz. The change in the output high voltage is $\pm 0.5\%$ at all line conditions.
- **2. Line Current**: Maximum line current is 120 A/phase at 400 V input voltage and 140 kV, 430 mA output.
- **3.** Maximum Power: 60 kW (120 kV, 500 mA or 140 kV, 430 mA) up to 10 seconds. Average power: 7 kV.

C - 2 Nov 2001

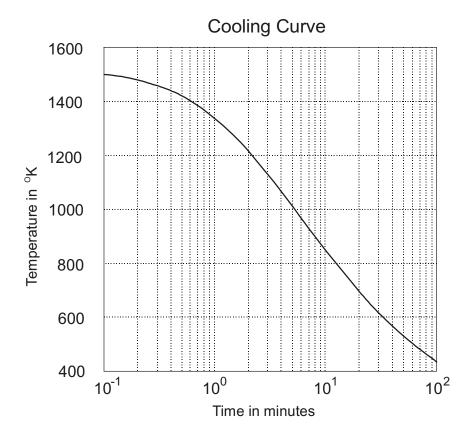


Figure C-1a.—Cooling Curve

C

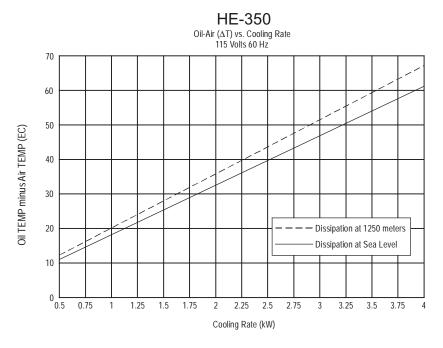


Figure C-1b.—Housing Cooling Curves

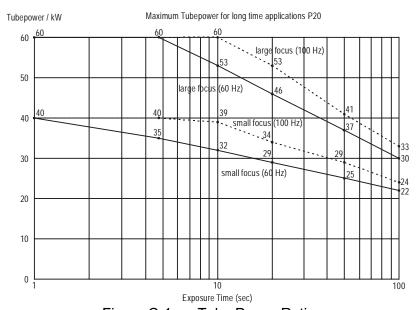


Figure C-1c.—Tube Power Rating

C - 4 Nov 2001

User's Dose and Imaging Information

(As required by the US DHHS, pursuant to 21 CFR, Chapter I, subchapter J, paragraph 1020.33).

The scanner is designed for scanning the head and the body. Therefore, dose and image quality information are provided separately for head and body scans according to the Code of Federal Regulations (21 CFR).

The phantoms used are described in the section on phantoms, earlier.

Phantoms and Measurement Methods

Dose Phantoms

"CT Dosimetry Phantom" is the phantom used for determining the dose delivered by a CT X-ray system. The phantoms are right circular cylinders of polymethyl methacrylate, 15 cm long. Their density is 1.19 ± 0.01 grams/cc. The phantom for testing CT imaging of the body has a diameter of 32.0 cm, and the phantom for the head has a diameter of 16.0 cm.

The phantom provides means for the placement of dosimeter(s) along its axis of rotation and along a line parallel to the axis of rotation, 1.0 cm from the outer surface and within the phantom. The dosimeters are TLD crystals (3.2 mm x 3.2 mm x 0.9 mm) or 10 cm long pencil ionization chamber.

CTDI Definition

"Computed Tomography Dose Index" (CTDI) is the integral of the dose profile along a line perpendicular to the tomographic plane divided by the product of the nominal tomography section thickness and the number of tomograms produced in a single scan as follows:

$$CTDI_{FDA} = \frac{1}{nT} \prod_{-7T}^{+7T} D(z) dz$$
 -OR- $CTDI_{100} = \frac{1}{nT} \prod_{-50mm}^{+50mm} D(z) dz$

where: z = Position along a line perpendicular to the tomographic plane

D(z) = Dose to acrylic (CTDI_{FDA}) at position z -OR-

Dose to Air (CTDI₁₀₀) at position z

T = Nominal tomographic section thickness

n = Number of tomograms produced in a single scan

The CTDI definition assumes that for a multiple tomogram system the scan increment between adjacent slices is nT.

Image Quality - Definitions

1. Noise

The phantoms used for noise measurement are:

Head phantom

184mm diameter water with a PVC shell (8mm wall thickness).

The CT number of water is 0 ± 4

The CT number of PVC shell is $\pm 1200 \pm 200$.

Body phantom

300mm diameter Nylon (Aculon).

The CT number is 100 ± 10 .

The phantoms are placed on the patient table stretcher.

Noise is measured using an ROI of:

 $7000 \pm 2000 \text{ mm}^2$ area for head phantom $14000 \pm 1000 \text{ mm}^2$ area for body phantom

Refer to ROI section in **Chapter 6, Vol. 1 - Graphics**, for instructions.

The SD as displayed on the screen is divided by (AV+1000) and multiplied by 100 to transform the CT numbers to a percentage of the material absorption.

The maximum deviation from the stated noise is 20%.

2. Modulation Transfer Function

The impulse response and the tomographic thickness (slice thickness) are not dependent upon the phantom dimensions. They are therefore measured on the physics layer of the system phantom (Appendix B).

The phantom physics layer diameter is 200 mm (186mm diameter of water in a 8mm PVC shell).

C - 6 Nov 2001

The impulse response is measured on a 0.18 mm Cu wire using the MISC, Impulse Response program. The MTF curve is calculated from the impulse response on a separate computer.

The maximum deviation of the MTF curve is 15%.

3. Tomographic Thickness Measurement

In the phantom shown in Appendix B, two aluminum strips at 45 deg. give projections of the sensitivity profile in the image plane. The profiles of the projections are equivalent to the sensitivity profiles, and the FWHM of the profile is the nominal tomographic thickness.

The profile may be measured by the **MISC**, **Slice Width** program. The maximum deviation of the sensitivity profiles is 20%.

The 0.5 mm and 1.0 mm results appear wider due to the limited resolution of the image and the thickness of the measuring ramp.

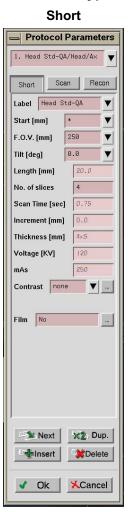
C

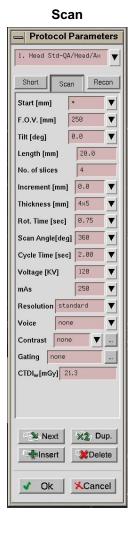
Head Scan Information

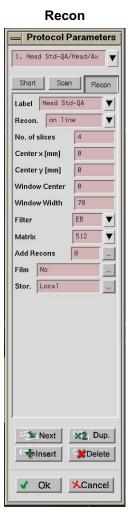
Head Dose

The 16 cm diameter dosimetry phantom is placed in the center of the Gantry opening on the standard head support with one of the dosimeters at the maximum dose position.

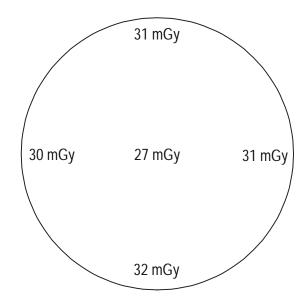
Typical Head CT Scan Conditions of Operation







(i) The CTDI for the typical Head CT scan are:



Maximum deviation from the above values is $\pm 20\%$.

(ii) Scan diameter, mAs, Slice Thickness and Voltage Dependence

- a. Scan Diameter Dependence—The CTDI is not dependent on the scan diameter.
- b. Tube current-exposure time product (mAs) dependence: The dose increases linearly with the current-exposure time product. The CTDI in the center of the head phantom depends on the mAs as follows:
 - Minimum CTDI, at 10 mAs, is $0.040 \pm 20\%$ of the CTDI at 250 mAs
 - Mid-range CTDI, at 500 mAs, is $1.99 \pm 20\%$ of the CTDI at 250 mAs
 - Maximum CTDI, at 1165 mAs, is $4.66 \pm 20\%$ of the CTDI at 250 mAs



c. Slice Thickness Dependence:

Several slice thicknesses are selectable between 10 mm and 0.5 mm. The CTDI in the center of the head phantom depends on the slice thickness, as follows:

- The CTDI of the 2.5 mm slice thickness is $0.86 \pm 15\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 0.5 mm slice thickness is $0.42 \pm 30\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 10 mm slice thickness for Dual scan is 1.3 of the CTDI of the 5 mm slice thickness
- d. Voltage Dependence Center:

The X-ray voltage may be varied between 90 and 140 kV. The CTDI in the center of the head phantom, depends on the X-ray voltage as follows:

- With 140 kV the CTDI is $1.46 \pm 15\%$ of the 120 kV CTDI
- With 90 kV the CTDI is 0.45±15% of the 120 kV CTDI
- e. Voltage Dependence Edge

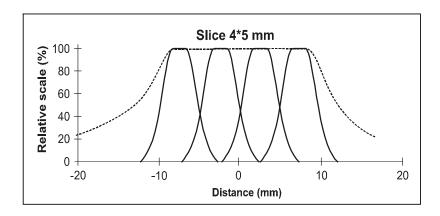
The CTDI at the peripheral or edge dose position in the head phantom depends on the X-ray voltage as follows:

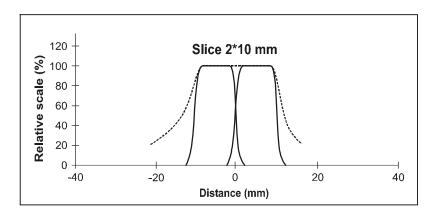
- With 140 kV the CTDI is $1.44 \pm 15\%$ of the 120 kV CTDI
- With 90 kV the CTDI is $0.46 \pm 15\%$ of the 120 kV CTDI
- **III.** The dose profiles at the center of the phantom superimposed on the sensitivity profiles are presented in Figure C-2.

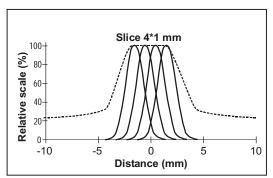
The maximum deviations from the drawn curves are $\pm 20\%$.

The sensitivity profiles were measured under the typical conditions of operation presented in the **Head Scan Information** section, while changing the slice thickness only. The limited resolution of the image causes the thin slice thicknesses to appear thicker than they really are.

C - 10 Nov 2001







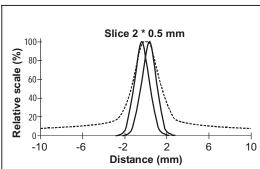


Figure C-2: Dose And Sensitivity Profiles, Head Scan – Mx8000

Image Quality

(i) Noise

The mean noise on the Head water phantom is $0.45\% \pm 0.05$ (4x5mm scan mode, 120kV, 250 mAs, filter = EB).

The phantom and measurement method are described earlier in the section on Phantom Image Quality.

(ii) Modulation Transfer Function

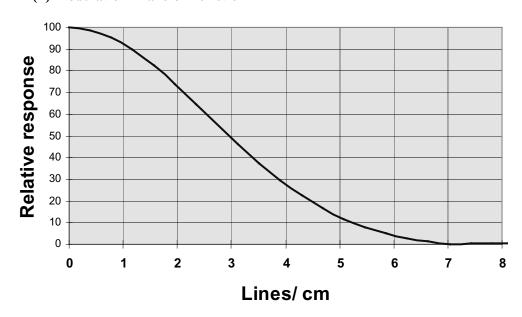


Figure C-3: Modulation Transfer Function, Head Scan - Mx8000

The maximum deviation is $\pm 15\%$

- (iii) The nominal tomographic section thicknesses are:
 - $2 \times 8 \text{ mm}, 2 \times 10 \text{ mm}, \pm 1 \text{mm},$
 - $4 \times 5 \text{ mm}$, $4 \times 2.5 \text{ mm}$, $\pm 0.5 \text{ mm}$,
 - $4 \times 1 \text{ mm}$, $2 \times 0.5 \text{ mm}$, $\pm 0.4 \text{ mm}$,

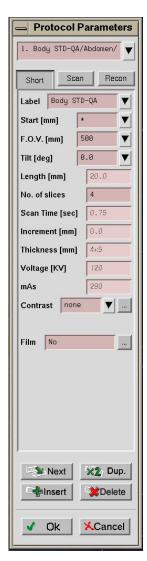
(iv) The sensitivity profiles are drawn in Figure C-2.

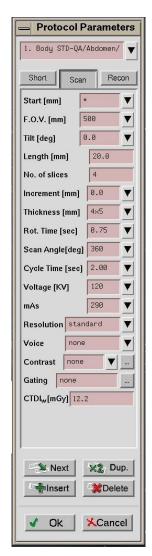
C - 12 Nov 2001

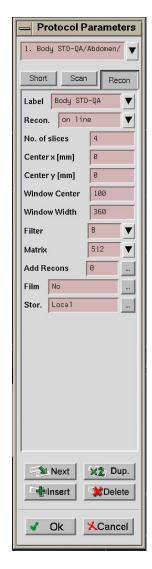
Body Scan Information

Typical Body CT Scan Conditions of Operation

Short Scan Recon







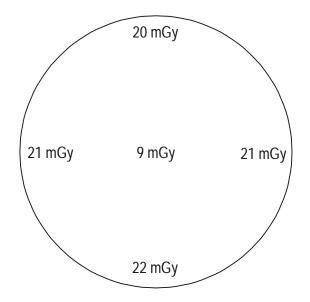


Body Dose

The maximum dose is delivered at the 6 o'clock position

The 32 cm diameter phantom is placed in the center of the Gantry opening on the stretcher with one of the dosimeters at the maximum dose position.

(i) The CTDI for the typical body CT scan are shown below.



Maximum deviation is $\pm 20\%$.

- (ii) Scan diameter, mAs, Slice thickness and Voltage Dependence
 - a. Scan Diameter Dependence—The CTDI is not dependent on the scan diameter.

C - 14 Nov 2001

b. Tube current-exposure time product (mAs) dependence:

The dose increases linearly with the current-exposure time product. The CTDI in the center of the body phantom depends on the mAs as follows:

- Minimum CTDI, at 10 mAs, is 0.035 ±20% of the CTDI at 290 mAs
- Mid-range CTDI, at 580 mAs, is $1.98 \pm 20\%$ of the CTDI at 290 mAs
- Maximum CTDI, at 1165 mAs, is 4.0 ±20% of the CTDI at 290 mAs

c. Slice Thickness Dependence:

Several slice thicknesses are selectable between 10 mm and 0.5 mm. The CTDI in the center of the head phantom depends on the slice thickness, as follows:

- The CTDI of the 2.5 mm slice thickness is $0.85 \pm 15\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 0.5 mm slice thickness is 0.42 $\pm 30\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 10 mm slice thickness for Dual scan is 1.3 of the CTDI of the 5 mm slice thickness

d. Voltage Dependence

The X-ray voltage used may be varied between 90 and 140 kV. The CTDI in the center of the body phantom depends on the X-ray voltage as follows:

- With 140 kV X-ray voltage it is 1.4 \pm 15% of the 120 kV CTDI
- With 90 kV X-ray voltage the CTDI is $0.4 \pm 15\%$ of the 120 kV CTDI

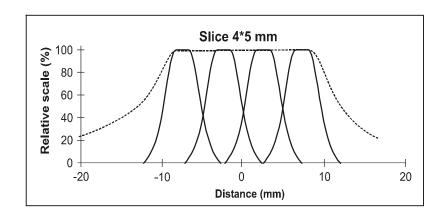


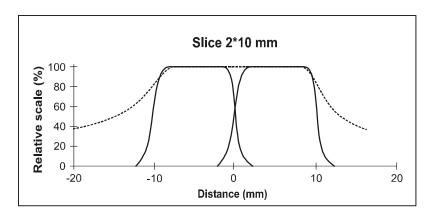
- (iii) The CTDI at the maximum dose position in the body phantom depends on the X-ray voltage, as follows:
 - With 140 kV X-ray voltage the CTDI is $1.4 \pm 15\%$ of the 120 kV CTDI
 - With 90 kV X-ray voltage the CTDI is $0.45 \pm 15\%$ of the 120 kV CTDI
- (iv) The dose profiles at the center of the phantom, superimposed on the sensitivity profiles, are presented in Figure C-4.

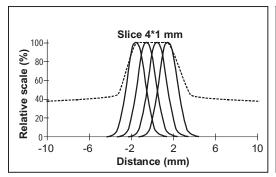
The maximum deviations from the drawn curves are $\pm 20\%$.

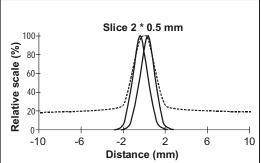
The sensitivity profiles were measured under the typical conditions of operation in the **Body Scan Information** section while changing the slice thickness only. The limited resolution of the image causes the thin slice thicknesses to appear thicker than they really are.

C - 16 Nov 2001









C

Figure C-4: Dose And Sensitivity Profiles, Body Scan – Mx8000

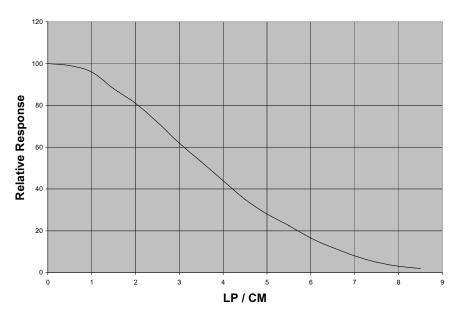
Body Image Quality

(i) Noise

The mean noise on the 300 mm diameter phantom is $1.3\% \pm 0.13$ (4x5mm scan mode, 120kV, 290 mAs, filter = B).

The phantom and measurement methods are described in the section on Phantom Image Quality.

(ii) Modulation Transfer Function with F.O.V.(mm) = 250



Modulation Transfer Function, Body Scan

The maximum deviation is $\pm 15\%$

(iii) The nominal tomographic section thicknesses are:

- 2 x 8 mm, 2 x 10 mm, ±1 mm
- $4 \times 5.0 \text{ mm}, 4 \times 2.5 \text{ mm}, \pm 0.5 \text{ mm}$
- $4 \times 1.0 \text{ mm}, 2 \times 0.5 \text{ mm}, \pm 0.4 \text{ mm}$

(iv) The sensitivity profiles are shown in Figure C-4.

C - 18 Nov 2001

Mx8000 CTDI₁₀₀ Dose Statements

$Mx8000\ CT$ System Standard Techniques For $CTDI_{100}$ Measurements

A list of technique factors for a "Standard Head" scan and a "Standard Body" scan, respectively are provided in the table below. These are defined for the purposes of dose references. The default technique factors for the Axial Brain and Axial Abdomen protocols are not necessarily the same as given here.

Table 1 - Standard Technique Factors for CTDI₁₀₀ Measurements – Mx8000

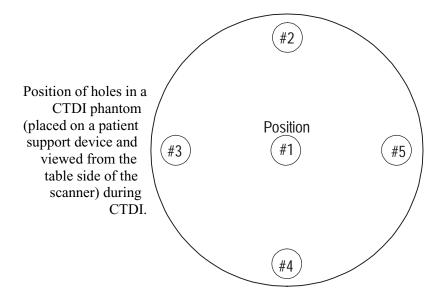
Parameters	Standard Head	Standard Body
Protocol	Head STD - QA	Body STD - QA
Image Size	250mm	500mm
Scan Field	500mm	500mm
Image Matrix	512 x 512	512 x 512
Scan Angle	360°	360°
Scan Time (seconds)	.75	.75
Image Algorithm	EB	В
kV	120	120
mAs	250	290
Slice Thickness	4 x 5mm	4 x 5mm
mA (Calculated)	333	333
Resolution Mode	Std.	Std.
Compensator & Filters	Std.	Std.



CTDI Phantoms

The CTDI dose phantoms are right circular cylinders of polymethyl methacrylate (lucite). The density of these phantoms is 1.19 g/cm³. The head phantom measures 16 cm in diameter while the body phantom has a diameter of 32 cm. The length of each phantom is approximately 15 cm.

The center hole is designated as Position 1. The maximum CTDI values for the outer positions in both the CTDI head and body phantoms were obtained at approximately the three o'clock position with respect to the patient aperture as viewed from the front (table side) of the scanner. This location has been designated as Position 5. Although all periphery positions produced very nearly the same dose results.



C - 20 Nov 2001

Computed Tomography Dose Index (100) or CTDI₁₀₀

The International Electrotechnical Commission (IEC) defines $CTDI_{100}$ in IEC 60601-2-44. This dose index is similar to the standard CTDI defined by the FDA but differs in the following two important aspects:

- **1.** The integral of the dose profile extends over 10cm rather than over 14 slice widths
- **2.** Although both dose profiles are measured using the same acrylic head and body phantoms, the $CTDI_{100}$ index specifies absorbed dose to air rather than absorbed dose to acrylic.

Table 2 - CTDI₁₀₀ For The MX8000 CT Scanner

Parameters	Center	Peripheral Positions			
	1	2 (12:00)	5 (3:00) Max	4 (6:00)	3 (9:00)
Head Dose (mGy)	33.9	36.8	37.2	36.8	36.4
Body Dose (mGy)	12.1	23.8	24.0	21.9	23.5

Standard Head and Body Technique Factors

120kVp, 250 mAs (Head), 290mAs (Body), .75 sec scan, 5mm slice width (4 x 5mm scan mode)

C

A. Tube current - exposure time product (mAs) dependence

Minimum CTDI₁₀₀, at 10 mAs is 0.04 of the CTDI₁₀₀ at 250 mAs Mid-range CTDI₁₀₀, at 500 mAs is 2.0 of the CTDI₁₀₀ at 250 mAs Maximum CTDI₁₀₀, at 1165 mAs is 4.66 of the CTDI₁₀₀ at 250 mAs

The CTDI₁₀₀ dose increases linearly with the current exposure time product at a given kVp for both the Head and Body modes.

B. Slice Thickness Dependence

Several slice widths are operator selectable between .5mm and 20mm.

The $CTDI_{100}$ in the central position depends upon the slice width as follows for the various system selections.

Table 3 - Examples of CTDI₁₀₀ Slice Width Dose - Mx8000

Slice Width (Scan Mode)	CTDI ₁₀₀ Dose (mGy) Normalized to the Table 2 Center Values (above)		
	Head	Body	
10mm (2 x 10mm)	1.0	1.0	
5mm (4 x 5mm)	1.0	1.0	
2,5mm (4 x 2.5mm)	1.1	1.1	
1 mm (4 x 1mm)	1.3	1.4	
0.5mm (2 x 0.5mm)	2.3	2.4	

C - 22 Nov 2001

C. CTDI₁₀₀ High Voltage Dependence

The x-ray high voltage is operator selectable from among the following choices: 90, 120, and 140 kVp. The $CTDI_{100}$ depends on the x-ray high voltage as follows:

Table 4 - CTDI₁₀₀ Normalization Factor Compared to 120 kVp - Mx8000

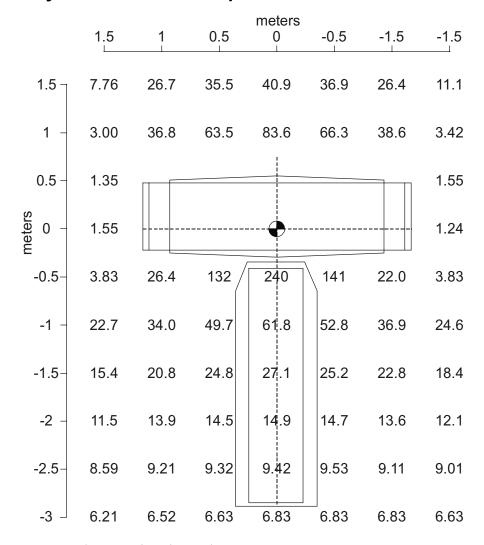
kVp	Head(Center	Body (Center)	Head (Peripheral)	Body (Peripheral)
90	0.43	0.39	0.47	0.39
140	n.a.	1.54	n.a.	1.50

n.a.: 140 kVp is not available for Head Protocols

All $CTDI_{100}$ specification tolerances are \pm 15 % of the values given or calculated.



IEC Stray Radiation Dose Map - Mx8000



Map values are given in $\mu Sv/1000$ mAs.

Measurement is with slice thickness of 20mm and 140 kV in the horizontal plane through the system axis.

A cylindrical PMMA phantom with a diameter of 32cm and a length of 16cm is positioned in the tomographical plane.

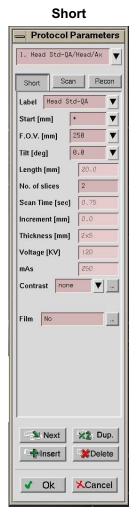
C - 24 Nov 2001

Head Scan Information – Mx8000D

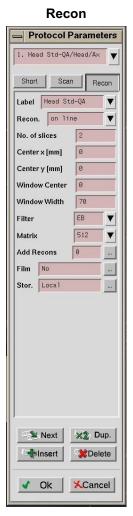
Head Dose

The 16 cm diameter dosimetry phantom is placed in the center of the Gantry opening on the standard head support with one of the dosimeters at the maximum dose position.

Typical Head CT Scan Conditions of Operation

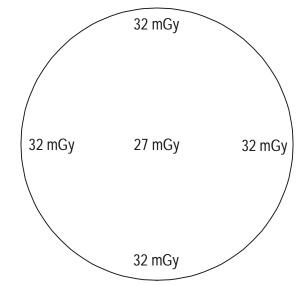






Mx8000 Dual

(i) The CTDI for the typical Head CT scan are:



Maximum deviation from the above values is $\pm 20\%$.

(ii) Scan diameter, mAs, Slice Thickness and Voltage Dependence

- a. Scan Diameter Dependence—The CTDI is not dependent on the scan diameter.
- b. Tube current-exposure time product (mAs) dependence:
 The dose increases linearly with the current-exposure time
 product. The CTDI in the center of the head phantom depends
 on the mAs as follows:
 - Minimum CTDI, at 14 mAs, is $0.056 \pm 20\%$ of the CTDI at 250 mAs
 - Mid-range CTDI, at 400 mAs, is $1.66 \pm 20\%$ of the CTDI at 250 mAs
 - Maximum CTDI, at 800 mAs, is 3.2 \pm 20% of the CTDI at 250 mAs

C - 26 Nov 2001

c. Slice Thickness Dependence:

Several slice thicknesses are selectable between 10 mm and 0.5 mm. The CTDI in the center of the head phantom depends on the slice thickness, as follows:

- The CTDI of the 2.5 mm slice thickness is $0.74 \pm 15\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 0.5 mm slice thickness is $0.74 \pm 30\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 10 mm slice thickness for Dual scan is 1.2 of the CTDI of the 5 mm slice thickness
- d. Voltage Dependence:

The X-ray voltage may be varied between 90 and 140 kV. The CTDI in the center of the head phantom, depends on the X-ray voltage as follows:

- With 140 kV the CTDI is $1.46 \pm 15\%$ of the 120 kV CTDI
- With 90 kV the CTDI is 0.43±15% of the 120 kV CTDI

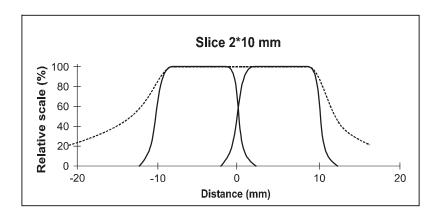
The CTDI at the maximum dose position in the head phantom depends on the X-ray voltage as follows:

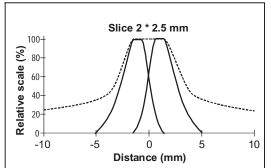
- With 140 kV the CTDI is $1.44 \pm 15\%$ of the 120 kV CTDI
- With 90 kV the CTDI is $0.46 \pm 15\%$ of the 120 kV CTDI
- (iii) The dose profiles at the center of the phantom superimposed on the sensitivity profiles are presented in Figure C-5.

The maximum deviations from the drawn curves are $\pm 20\%$.

The sensitivity profiles were measured under the typical conditions of operation presented in the **Head Scan Information** section, while changing the slice thickness only. The limited resolution of the image causes the thin slice thicknesses to appear thicker than they really are.







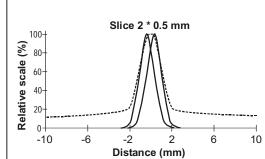


Figure C-5: Dose And Sensitivity Profiles, Head Scan - Mx8000D

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Image Quality

(i) Noise

The mean noise on a Head water phantom is $0.45\% \pm 0.05$ (2x5mm scan mode, 120kV, 250 mAs, filter = EB).

The phantom and measurement methods are described in the section on Phantom Image Quality.

(ii) Modulation Transfer Function

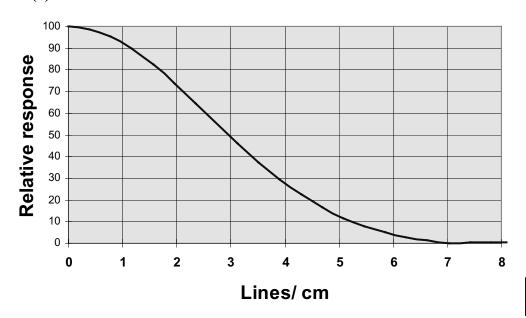


Figure C-6: Modulation Transfer Function, Head Scan - Mx8000D

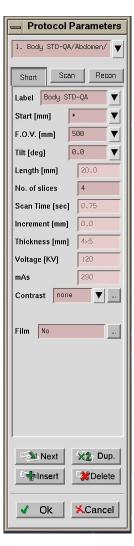
The maximum deviation is $\pm 15\%$

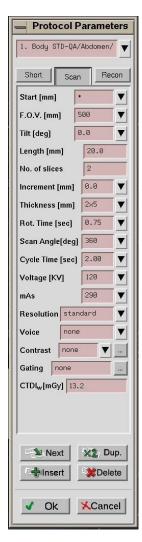
- (iii) The nominal tomographic section thicknesses are:
 - $2 \times 10 \text{ mm}, 2 \times 8 \text{ mm}, \pm 1 \text{mm},$
 - $2 \times 5 \text{ mm}$, $2 \times 2.5 \text{ mm}$, $\pm 0.5 \text{ mm}$,
 - $2 \times 1 \text{ mm}$, $2 \times 0.5 \text{ mm}$, $\pm 0.4 \text{ mm}$,
- (iv) The sensitivity profiles are drawn in Figure C-5.

Body Scan Information

Typical Body CT Scan Conditions of Operation

Short Scan Recon







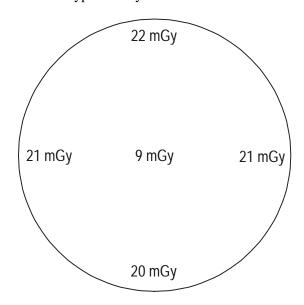
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Body Dose

The maximum dose is delivered at the 6 o'clock position

The 32 cm diameter phantom is placed in the center of the Gantry opening on the stretcher with one of the dosimeters at the maximum dose position.

(i) The CTDI for the typical body CT scan are shown below.



Maximum deviation is $\pm 20\%$.

- (ii) Scan diameter, mAs, Slice thickness and Voltage Dependence
 - a. Scan Diameter Dependence—The CTDI is not dependent on the scan diameter.



b. Tube current-exposure time product (mAs) dependence:

The dose increases linearly with the current-exposure time product. The CTDI in the center of the body phantom depends on the mAs as follows:

- Minimum CTDI, at 14 mAs, is $0.052 \pm 20\%$ of the CTDI at 290 mAs
- Mid-range CTDI, at 400 mAs, is $1.38 \pm 20\%$ of the CTDI at 290 mAs
- Maximum CTDI, at 800 mAs, is $2.76 \pm 10\%$ of the CTDI at 290 mAs

c. Slice Thickness Dependence:

Several slice thicknesses are selectable between 10 mm and 0.5 mm. The CTDI in the center of the head phantom depends on the slice thickness, as follows:

- The CTDI of the 2.5 mm slice thickness is $0.63 \pm 15\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 0.5 mm slice thickness is $0.47 \pm 30\%$ of the CTDI of the 5 mm slice thickness
- The CTDI of the 10 mm slice thickness for Dual scan is 1.4 of the CTDI of the 5 mm slice thickness

d. Voltage Dependence

The X-ray voltage used may be varied between 90 and 140 kV. The CTDI in the center of the body phantom depends on the X-ray voltage as follows:

- With 140 kV X-ray voltage it is 1.57 \pm 15% of the 120 kV CTDI
- With 90 kV X-ray voltage the CTDI is $0.4 \pm 15\%$ of the 120 kV CTDI
- (iii) The CTDI at the maximum dose position in the body phantom depends on the X-ray voltage, as follows:

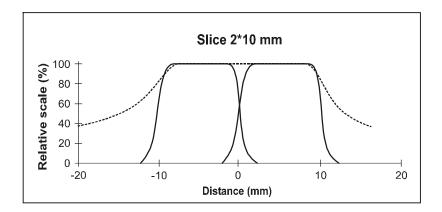
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- With 140 kV X-ray voltage the CTDI is $1.52 \pm 15\%$ of the 120 kV CTDI
- With 90 kV X-ray voltage the CTDI is $0.39 \pm 15\%$ of the 120 kV CTDI
- (iv) The dose profiles at the center of the phantom, superimposed on the sensitivity profiles, are presented in Figure C-7.

The maximum deviations from the drawn curves are $\pm 20\%$.

The sensitivity profiles were measured under the typical conditions of operation in the **Body Scan Information** section while changing the slice thickness only. The limited resolution of the image causes the thin slice thicknesses to appear thicker than they really are.

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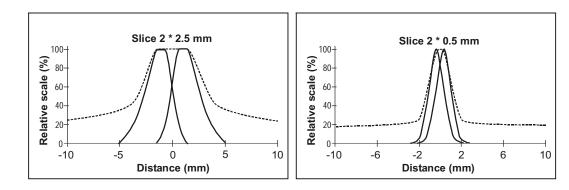


Figure C-7: Dose And Sensitivity Profiles, Body Scan – Mx8000D

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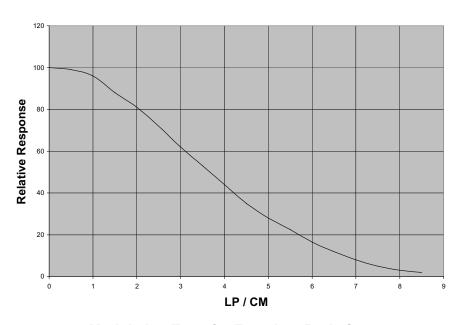
Body Image Quality

(i) Noise

The mean noise on the 300 mm diameter Body phantom is $1.3\% \pm 0.13$.

The phantom and measurement methods are described in the section on Phantom Image Quality.

(ii) Modulation Transfer Function with F.O.V.(mm) = 250



Modulation Transfer Function, Body Scan

The maximum deviation is $\pm 15\%$

(iii) The nominal tomographic section thicknesses are:

- $2 \times 10 \text{ mm}, 2 \times 8 \text{ mm}, \pm 1 \text{mm}$
- $2 \times 5.0 \text{ mm}, 2 \times 2.5 \text{ mm}, \pm 0.5 \text{ mm}$
- $2 \times 1.0 \text{ mm}, 2 \times 0.5 \text{ mm}, \pm 0.4 \text{ mm}$

(iv) The sensitivity profiles are shown in Figure C-7.

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Mx8000D CTDI₁₀₀ Dose Statements

Mx8000D CT System Standard Techniques For CTDI₁₀₀ Measurements

A list of technique factors for a "Standard Head" scan and a "Standard Body" scan, respectively are provided in the table below. These are defined for the purposes of dose references. The default technique factors for the Axial Brain and Axial Abdomen protocols are not necessarily the same as given here.

Table 5 - Standard Technique Factors for CTDI₁₀₀ Measurements - Mx8000D

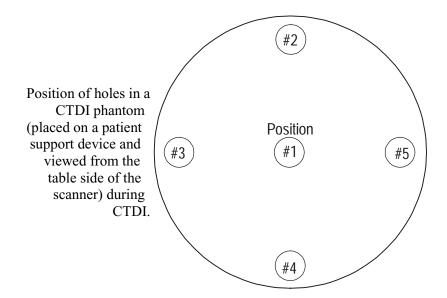
Parameters	Standard Head	Standard Body
Protocol	Axial Head	Axial Abdomen
Image Size	250mm	500mm
Scan Field	500mm	500mm
Image Matrix	512 x 512	512 x 512
Scan Angle	360°	360°
Scan Time (seconds)	.75	.75
Image Algorithm	EB	В
Kv	120	120
mAs	250	290
Slice Thickness	2 x 5mm	2 x 5mm
mA (Calculated)	333	387
Resolution Mode	Std.	Std.
Compensator & Filters	Std.	Std.

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CTDI Phantoms

The CTDI dose phantoms are right circular cylinders of polymethyl methacrylate (lucite). The density of these phantoms is 1.19 g/cm³. The head phantom measures 16 cm in diameter while the body phantom has a diameter of 32 cm. The length of each phantom is 15 cm.

The center hole is designated as Position 1. The maximum CTDI values for the outer positions in both the CTDI head and body phantoms were obtained at approximately the 12 o'clock or top position with respect to the patient aperture as viewed from the front (table side) of the scanner. This location has been designated as Position 2. Note that all periphery positions produced very nearly the same dose results.



Computed Tomography Dose Index (100) or CTDI₁₀₀

The International Electrotechnical Commission (IEC) defines $CTDI_{100}$ in IEC 60601-2-44.

$$CTDI_{100} = \frac{1}{nT} I_{-5cm}^{+5cm} D(z) dz$$

where:

D(z) is the Dose Profile along a line z perpendicular to the tomographic plane, where dose is measured in absorbed dose to air

N is the number of tomographic sections produced in a single rotation of the radiation source

T is the nominal tomographic section thickness

This dose index is similar to the standard CTDI defined by the FDA but differs in the following two important aspects:

- 1. The integral of the dose profile extends over 10cm rather than over 14 slice widths.
- **2.** Although both dose profiles are measured using the same acrylic head and body phantoms, the $CTDI_{100}$ index specifies absorbed dose to air rather than absorbed dose to acrylic.

Table 6 - CTDI₁₀₀ For The MX8000D CT Scanner

Parameters	Center	Peripheral Positions			
	1	12:00 (2)	3:00 (5) Max	6:00 (4)	9:00 (3)
Head Dose (mGy)	34.8	38.7	38.3	38.3	38.3
Body Dose (mGy)	12.8	26.0	25.5	24.1	25.4

Standard Head and Body Technique Factors

120kVp, 250 mAs (Head), 290 mAs (Body), .75 sec scan, 5mm slice width (2 x 5mm scan mode)

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A. Tube current - exposure time product (mAs) dependence

Minimum CTDI₁₀₀, at 14 mAs is 0.056 of the CTDI₁₀₀ at 250 mAs Mid-range CTDI₁₀₀, at 400 mAs is 1.6 of the CTDI₁₀₀ at 250 mAs Maximum CTDI₁₀₀, at 800 mAs is 3.2 of the CTDI₁₀₀ at 250 mAs

The CTDI₁₀₀ dose increases linearly with the current exposure time product at a given kVp for both the Head and Body modes.

B. Slice Thickness Dependence

Several slice widths are operator selectable between .5mm and 20mm.

The $CTDI_{100}$ in the central position depends upon the slice width as follows for the various system selections.

Table 7 - Examples of CTDI₁₀₀ Slice Width Dose - Mx8000D

Slice Width (Scan Mode)		CTDI ₁₀₀ Dose (mGy) Normalized to the Table 6 Center Values (above)		
		Head	Body	
20mm	(2 x 10mm)	0.94	0.95	
16mm	(2 x 8mm)	0.99	0.99	
5mm	(2 x 5mm)	1.0	1.0	
2,5mm	(2 x 2.5mm)	1.0	1.0	
1 mm	(2 x 1mm)	1.4	1.3	
0.5mm	(2 x 0.5mm)	2.1	2.0	

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C. CTDI₁₀₀ High Voltage Dependence

The x-ray high voltage is operator selectable from among the following choices: 90, 120, and 140 kVp. The $CTDI_{100}$ depends on the x-ray high voltage as follows:

Table 8 - CTDI₁₀₀ Normalization Factor Compared to 120 kVp - Mx8000D

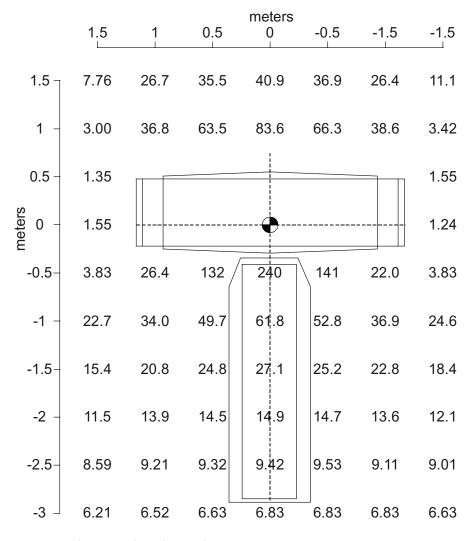
kVp	Head(Center	Body (Center)	Head (Peripheral)	Body (Peripheral)
90	0.43	0.40	0.47	0.39
140	n.a.	1.57	n.a.	1.52

n.a.: 140 kVp is not available for Head Protocols

All CTDI $_{100}$ specification tolerances are $\pm\ 15$ % of the values given or calculated.

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IEC Stray Radiation Dose Map - Mx8000D



Map values are given in μSv/1000 mAs.

Measurement is with slice thickness of 20mm and 140 kV in the horizontal plane through the system axis.

A cylindrical PMMA phantom with a diameter of 32cm and a length of 16cm is positioned in the tomographical plane.